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Vascular Plant Communities of the Green River Lowlands in Northwestern Illinois

John E. Ebinger, Loy R. Phillippe, William C. Handel,
Connie J. Cunningham, William E. McClain,
Randy N. Nyboer, and Todd Bittner

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ABSTRACT

A few high-quality prairies still exist in the sand deposits of the Green River Lowlands. The most extensive remnants are in the Green River State Wildlife Area, Lee County, Illinois. Three upland prairie communities were surveyed; a dry sand prairie dominated by *Schizachyrium scoparium*, *Ambrosia psilostachya*, and *Amorpha canescens*; a dry-mesic sand prairie dominated by *Sorghastrum nutans*, *Schizachyrium scoparium*, *Antennaria plantaginifolia*, and *Liatris aspera*; and a mesic sand prairie where *Sorghastrum nutans* and *Andropogon gerardii* were the dominant grasses, and *Parthenium integrifolium*, *Fragaria virginiana*, *Liatris pycnostachya*, and *Euthamia gymnospermoides* the common forbs. The lowlands, which included approximately 325 ha, were dominated by the exotic *Phalaris arundinacea*, but high-quality wet sand prairie, sedge meadow, and marsh communities existed. The wet sand prairies were dominated by *Spartina pectinata*, *Helianthus grosseserratus*, and *Solidago canadensis*; the sedge meadows were dominated by *Carex haydenii*, *Calamagrostis canadensis*, and *Persicaria coccinea*; the marsh communities were divided into distinct vegetation zones. These vegetation zones were surveyed in 2002 and subjected to an extensive uncontrolled fire in 2005. Surveys completed in 2006 and 2007 were used to determine successional changes resulting from the fire. These studies suggested that most communities were returning to the species composition found before the 2005 fire.

INTRODUCTION

Sand deposits are relatively common in the northern half of Illinois, accounting for about 5% of the land area of the state. Most occur on glacial outwash plains resulting from erosion events associated with Wisconsin glaciation (Wildman and Frye 1970, King 1981). One extensive sand deposit is the Green River Lowlands in parts of Bureau, Henry, Lee, and Whiteside counties in northwestern Illinois. Located just to the west of the terminal moraine of Wisconsin glaciation, extensive amounts of sand and gravel were deposited in these areas during intermittent warm periods of the Wisconsin Episode (Killey 1998). These sands were reworked by wind, creating numerous small sand dune fields (Willman and Frye 1970).

These sand deposits are scattered throughout the Green River Lowland Section of the Grand Prairie Natural Division (Schwegman 1973). This section, which includes the broad valley of the Green River and lower Rock River, was formed about 10,000 years ago during the retreat of Wisconsin glaciation (Willman and Frye 1970). During early European settlement this section had extensive marshes and wet prairies associated with the Great Inlet Swamp that covered part of Lee County (Lyman 1901, McClain 1992, McClain and Ebinger 2000).

Sand deposits containing numerous small dunes were common. Forests and savanna communities grew on the dry sandy ridges, while floodplain forests occurred along the rivers. In recent history, grazing, drainage, and cultivation have disturbed nearly all of this section, while fire suppression has resulted in the formation of many poor-quality sand forests containing numerous early successional and non-native (exotic) species.

Gleason (1910) referred to the vegetation of the Green River Lowlands in his extensive study of the Illinois sand deposits. Until recently that study was the only reference available of the flora of this region. Phillippe et al. (2000, 2003) studied some of the sand prairie communities at the Green River State Wildlife Area (GRSWA), Handel et al. (2003) examined the sand prairie remnants and sedge meadows of the Richardson Wildlife Foundation, a private hunting club, and McClain et al. (2003) examined the vegetation of a dune ridge at Foley Sand Prairie Nature Preserve. The purpose of the present study was to determine the composition and structure of the vegetation of the sand communities present in the GRSWA. Also, as the result of an extensive uncontrolled fire in the marsh community of the GRSWA in 2005, we examined the changes in the vegetation of this area in 2006 and 2007.

STUDY AREA

The GRSWA, located in the southwestern part of Lee County, about 23 km south of Dixon, Illinois (S7, S8, S17, S18, T19N R9E and S12, S13 T19N R8E), is the most extensive area in public ownership in the Green River Lowlands (Ebinger et al. 2008) (Fig. 1). The initial purchase of land started in 1938 under the Federal Aid in Wildlife Restoration Act to provide habitat for waterfowl and dwindling populations of the Greater Prairie Chicken (*Tympanuchus cupido*). Subsequent land purchases increased the size of the GRSWA to 1,025 ha (2,533 acres). The area was under

intense grazing pressure prior to 1938, and was subject to much brush encroachment resulting from fire suppression until 1987. Much of the grasslands of the GRSWA were mowed annually from June through September until 1998 (Todd Bittner, personal observations). During the natural areas inventory in the mid-1970s no high-quality natural areas were reported for the GRSWA (White 1978).

Since 1993 an active management program at the GRSWA has been implemented, including burning, brush removal, restoration plantings, and exotic species control. In addition to prescribed fire used to manage the prairie communities, most of the forested areas,

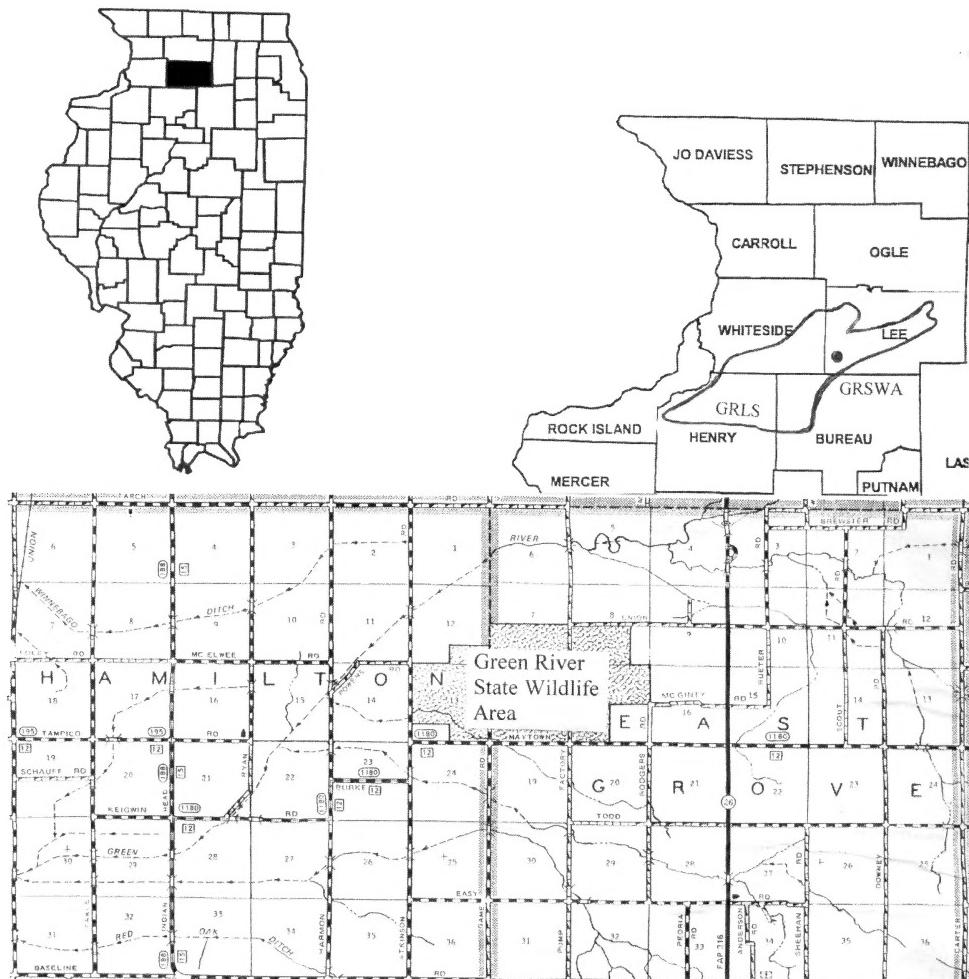


Figure 1. Location of the Green River State Wildlife Area (GRSWA) in the Green River Lowland Section (GRLS) of the Grand Prairie Natural Division, about 24 km south of Dixon, Lee County, Illinois.

including the woody understory, were removed in the fall and winter of 2001. Beginning in 1987, many of the dry, dry-mesic, and mesic sand prairies were intentionally burned every one to three years. Presently this multiple-use area is managed for the protection and enhancement of wildlife and natural heritage resources.

The soils of the uplands at the GRSWA are Billett fine sandy loam, Chelsea fine sand, and Sparta loamy sand (Zwicker 1985). These soils, which occur on side slopes and ridges of dunes, are relatively low in organic matter, well drained, and have a surface layer of dark gray to yellow brown friable fine sand. The wetland soils are Adrian muck, Gilford fine sandy loam, Orio mucky sandy loam, and Orio sandy loam. Very high in organic material, these soils occur on level, poorly drained outwash plains and contain surface water for much of the winter and early spring.

On 18 October 2005 the extensive marsh located at the western portion of the GRSWA was burned in an attempt to decrease the growth of the exotic species *Phalaris arundinacea* (Lavergne and Molofsky 2006). Dry conditions at the time of the controlled burn resulted in extensive peat fires, some of which continued to burn for approximately 30 days. Water was pumped into some areas of the marsh from central pivot irrigation wells located on surrounding farms, and some fires were repeatedly disked and flooded.

The climate in northwestern Illinois is continental with warm summers and cold winters. Based on weather data from Dixon, located near the north-central edge of the Green River Lowlands, the mean annual precipitation is 94.7 cm, June having the highest rainfall (12.4 cm), and February the lowest (3.6 cm). Mean annual temperature is 8.5°C with the hottest month being July (average of 22.3°C), and the coldest January (average of -7.9°C). There are an average of 161 frost-free days (Midwestern Regional Climate Center 2008).

METHODS

Vascular Plant Species and Communities:

The natural areas studied were visited at various times throughout the growing seasons of 2000 through 2007. Voucher specimens of each plant species were collected, identified, and deposited in the herbarium of the Illinois Natural History

Survey, Champaign, Illinois (ILLS), and the Stover-Ebinger Herbarium of Eastern Illinois University, Charleston, Illinois (EIU). Criteria for designating non-native species followed Mohlenbrock (2002), Gleason and Cronquist (1991), and Taft et al. (1997). Nomenclature follows Mohlenbrock (2002). The plant communities encountered were designated and plotted using the classification system of White and Madany (1978). The locations of threatened and endangered plant species were recorded (Herkert and Ebinger 2002).

The Floristic Quality Index (FQI) was determined for each community type using the coefficient of conservatism (CC) assigned each species based on a species tolerance to disturbance and its fidelity to habitat integrity (Taft et al. 1997). The FQI, therefore, is a weighted index of species richness ($N =$ number of species present on a site), and is the arithmetic product of the average coefficient of conservatism (C-Value = the average of all species CCs) multiplied by the square root of the species richness (\sqrt{N}) of an inventory site: $FQI = C\text{-Value} (\sqrt{N})$. For relatively small areas that are intensively studied, the FQI gives a rapid means of comparison and an indication of the floristic integrity of the site. Using the FQI along with other floristic measures, such as quadrat-based sampling methods, provide a way to make comparisons among sites. Prairies with an FQI of 35 or higher are considered high-quality natural areas (Taft et al. 1997). All species recorded for the plots as well as all other species observed in the community were used to determine the FQI of each site.

The Sorenson Index of Similarity (ISs) was used to determine the degree of vegetation similarity among the prairie areas surveyed throughout the Mississippi River sand deposits (Mueller-Dombois and Ellenberg 1974). In this index [ISs = $2C/(A+B) \times 100$], where A equals the number of species in the first community, B equals the number of species in the second community, while C equals the number of species common between the two communities.

Ground Layer Sampling: In mid-summer of 2003 through 2007 line transects were located randomly along cardinal compass directions within the sand prairies, sedge meadows, and marsh communities. Many of the sites were sampled two or three times during the study; the starting points of each transect were

marked with metal stakes and relocated using GPS coordinates during each survey. The dry, dry-mesic, mesic, and wet sand prairies were surveyed once (2006), whereas the marsh communities were surveyed in 2002, and again in 2006 and 2007 after a very hot uncontrolled fire burned the marsh in 2005. The sedge meadow located next to a wet sand prairie was surveyed in 2006, and the sedge meadow associated with the marsh in 2002, 2006, and 2007. Two transects were randomly located within each community; along each transect, 1m² plots were located at 1- or 5-m intervals (on larger sites the plots were more widely spaced) on alternating sides of the transects (n=50). A random numbers table was used to determine the number of meters (0 to 9) a plot was located from the transect line. Species cover was determined using the Daubenmire (1959) cover class system as modified by Bailey and Poulton (1968). Only ground layer species rooted within the plot frame were recorded. The modified Daubenmire cover scale is as follows: class 1 = 0 to 1%; class 2 = >1 to 5%; class 3 = >5 to 25%; class 4 = >25 to 50%; class 5 = >50 to 75%; class 6 = >75 to 95%; class 7 = >95 to

100%. Importance value (IV) was determined by summing relative cover and relative frequency. The location of the community study sites are shown in Figure 2 along with extent of the marsh at the GRSWA and the area burned in 2005.

Forest Sampling: In the summer of 2001 the overstory of the forests at the GRSWA were sampled using circular plots 0.3 ha in size, spaced at 25-m intervals along line transects (n=10). Within each plot all living individuals ≥ 10.0 cm dbh were identified and diameters recorded. From these data, living-stem density (stems/ha), basal area (m²/ha), relative density, relative dominance, importance value (IV), and average diameter (cm) were calculated for each species. Determination of the IV followed the procedure used by McIntosh (1957), and is the sum of the relative density and relative dominance (basal area). Woody understory composition and density (stems/ha) were determined using nested circular plots 0.0001, 0.001, and 0.01 ha in size, located at 15-m intervals along randomly located east-west transects within each study area. Four additional 0.0001-ha

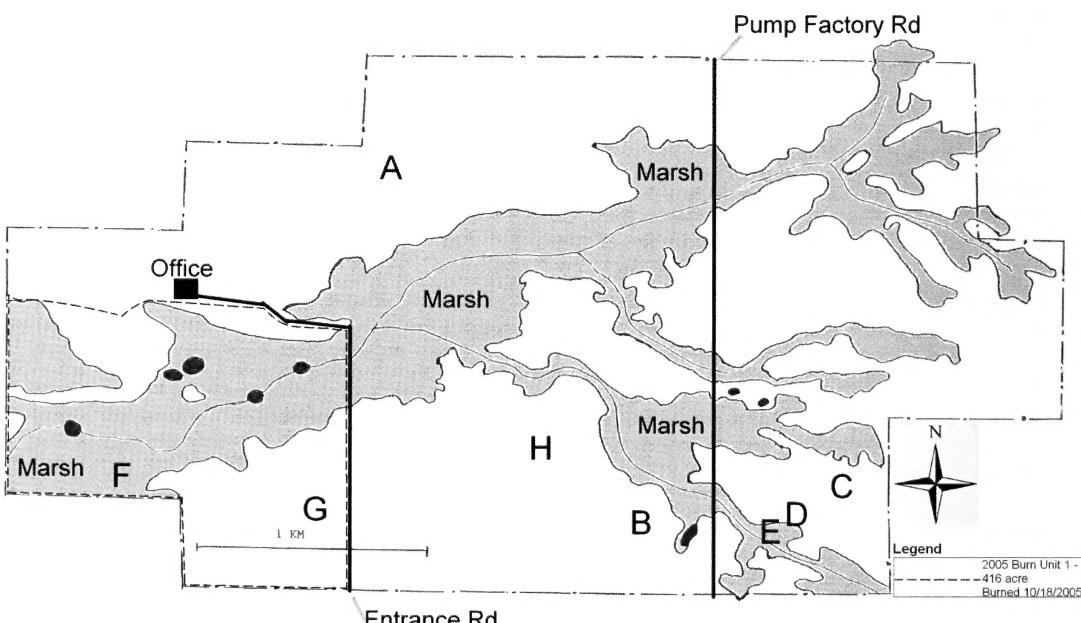


Figure 2. The location of the community studied at the GRSWA along with extent of the marsh and the area burned in 2005. A—dry sand prairie, B—dry-mesic sand prairie, C—mesic sand prairie, D—wet sand prairie, E—sedge meadow (east), F—sedge meadow (west), G—successional lowland, and H—successional upland.

circular plots were located 6 m from the center point of each plot along cardinal compass directions. In the 0.0001-ha plots, woody seedlings (≤ 50 cm tall) were counted; in the 0.001-ha circular plots small saplings (>50 cm tall and < 2.5 cm dbh) were recorded; and in the 0.01-ha circular plots large saplings (2.5– < 10.0 cm dbh) were tallied.

During the late fall and winter of 2001, these forested areas, including their woody understory, were removed to reestablish prairie vegetation. The bare sand and woody waste were left on the sites and no prairie seed was planted. The resulting lowland and upland successional communities were examined in 2002, 2003, and 2006. Within each community four transects were randomly located. Along each transect, 1m² plots were located at 1-m intervals alternately along transects (n=100). A random numbers table was used to determine the number of meters (0 to 9) a plot was located from the transect line. Species cover was determined using the Daubenmire (1959) cover class system as modified by Bailey and Poulton (1968). Importance values were determined by summing relative cover and relative frequency.

Aerial photographs from 1939, 1951, 1970, and 1988 were digitized to determine woody encroachment (trees and large shrubs) at the GRSWA. These aerial photographs were borrowed from the University of Illinois Map Library and scanned with a Microtek ScanMaker. Twenty-one stratified random 5-ha sites, approximately 10.12% of the GRSWA, were interpreted and then digitized using ARC/INFO. The 1939, 1951, and 1970 photographic surveys were all flown in August whereas the 1988 aerial survey was flown in April.

RESULTS

Dry Sand Prairie: One high-quality dry sand prairie was encountered on the GRSWA (SW1/4 SW1/4 S7 T19N R9E; Fig. 2). This site, approximately 2 ha in size, was located on the ridge and upper slopes of a large stabilized sand dune composed of Chelsea fine sand. The dominant grasses, which did not exceed 1 m in height, were *Schizachyrium scoparium*, *Koeleria macrantha*, *Dichanthelium villosissimum*, and *Leptoloma cognatum*. *Ambrosia psilostachya* ranked second in importance, while other common forbs included *Chrysopsis camporum*, *Solidago nemoralis*, and *Coreopsis lanceolata* (Table 1). *Amorpha*

cansecens, *Rosa carolina*, and *Rhus aromatica* were the only woody species encountered in the plots. Based on the Sorenson Index of Similarity the dry sand prairie was very similar to the dry mesic sand prairie, but had no species in common with the sedge meadows (Table 2). Within the dry sand prairie, 48 taxa were recorded in the plots, including 4 exotic species, *Achillea millefolium* being the most important. Average bare ground and litter was 29%, the vegetation being relatively sparse. A total of 94 species were observed in the dry sand prairie for an FQI of 36.16 and a mean CC of 3.73.

Dry-mesic Sand Prairie: On the east side of the GRSWA was a dry-mesic sand prairie on Chelsea fine sand. This sand prairie, covering 3 ha, occupied the dune ridge and upper dune slopes (NE1/4 SW1/4 S17 T19N R9E; Fig. 2). The dominant grasses, which were between 0.9 and 1.3 m tall, included *Sorghastrum nutans* and *Schizachyrium scoparium*. Other relatively common grasses were shorter and included *Dichanthelium villosissimum*, *D. oligosanthes*, *D. perlongum*, and *Leptoloma cognatum* (Table 1). Important forbs included *Antennaria plantaginifolia*, *Liatris aspera*, *Euthamia gymnospermoides*, and *Euphorbia corollata*. *Antennaria plantaginifolia* commonly covered small areas in a near monoculture. Based on the Sorenson Index of Similarity, the dry-mesic and mesic prairies were similar but had only a few species in common with the wet prairies and sedge meadows (Table 2). Within the dry-mesic sand prairie, 37 species were found in the plots, including three exotic species, *Rumex acetosella*, *Poa pratensis*, and *Achillea millefolium*. Vegetation was relatively sparse as indicated by the high values for bare ground and litter (25%). A total of 102 species were observed in the dry-mesic sand prairie resulting in a FQI of 37.77 and a mean CC of 3.74.

Mesic Sand Prairie: One high-quality mesic to wet-mesic sand prairie occurred on the GRSWA (SW1/4 S17 T19N R9E; Fig. 2). This extensive area of approximately 34 ha in size had high species diversity and contained few exotic species. Topographic differences were responsible for the mosaic of sand species that existed here, varying from the dry-mesic sand prairies on the low dune ridges to sand

Table 1. Frequency (%), mean cover (% of total cover), and importance value (IV) of the ground layer species (with IVs >2.0) encountered in late summer of 2006 in a dry sand prairie, a dry-mesic sand prairie, and a mesic sand prairie, Green River State Wildlife Area, Lee County, Illinois. (n = 50) (*exotic species)

Species	Dry Sand Prairie			Dry-mesic Sand Prairie			Mesic Sand Prairie		
	Freq. %	Mean Cover	IV	Freq. %	Mean Cover	IV	Freq. %	Mean Cover	IV
<i>Schizachyrium scoparium</i>	100	26.00	48.7	96	6.32	15.1	2	0.06	0.1
<i>Ambrosia psilostachya</i>	100	10.58	25.2	--	--	--	--	--	--
<i>Amorpha canescens</i>	64	5.91	14.8	--	--	--	--	--	--
<i>Chrysopsis camporum</i>	38	4.61	10.5	--	--	--	--	--	--
<i>Solidago nemoralis</i>	48	3.59	9.9	14	0.17	1.1	10	0.25	0.8
<i>Coreopsis lanceolata</i>	54	3.14	9.7	--	--	--	--	--	--
<i>Cyperus lupulinus</i>	86	0.53	8.7	44	0.27	3.2	--	--	--
<i>Rosa carolina</i>	46	1.75	6.9	28	0.93	3.1	--	--	--
* <i>Achillea millefolium</i>	60	0.45	6.2	22	0.21	1.7	50	0.75	3.6
<i>Koeleria macrantha</i>	46	0.53	5.0	--	--	--	--	--	--
<i>Tephrosia virginiana</i>	14	2.31	4.8	--	--	--	--	--	--
<i>Dichanthelium villosissimum</i>	44	0.47	4.7	88	1.28	7.3	--	--	--
<i>Leptoloma cognatum</i>	42	0.41	4.4	52	1.00	4.7	--	--	--
<i>Liatris aspera</i>	22	0.89	3.4	100	8.80	18.9	--	--	--
<i>Polygala polygama</i>	32	0.16	3.1	100	0.55	7.0	--	--	--
<i>Asclepias verticillata</i>	30	0.15	2.9	4	0.02	0.3	--	--	--
* <i>Poa pratensis</i>	30	0.15	2.9	38	0.19	2.7	46	2.61	4.5
<i>Rhus aromatica</i>	10	1.02	2.5	--	--	--	--	--	--
* <i>Rumex acetosella</i>	24	0.12	2.4	62	0.76	5.0	--	--	--
<i>Dichanthelium oligosanthes</i>	16	0.08	1.6	80	0.75	6.1	--	--	--
<i>Sorghastrum nutans</i>	6	0.03	0.5	98	8.32	18.1	100	28.22	23.7
<i>Antennaria plantaginifolia</i>	2	0.06	0.3	88	16.45	29.2	6	0.08	0.4
<i>Lespedeza capitata</i>	2	0.06	0.3	74	2.34	8.0	4	0.02	0.3
<i>Euphorbia corollata</i>	2	0.01	0.2	96	5.26	13.6	--	--	--
<i>Euthamia gymnospermoides</i>	2	0.01	0.0	196	7.54	16.9	100	7.56	11.0
<i>Carex tonsa</i>	--	--	--	100	1.70	8.7	--	--	--
<i>Rubus flagellaris</i>	--	--	--	56	2.63	7.3	22	2.00	2.6
<i>Dichanthelium perlongum</i>	--	--	--	66	1.42	6.2	--	--	--
<i>Aristida basiramea</i>	--	--	--	62	0.31	4.4	--	--	--
<i>Andropogon gerardii</i>	--	--	--	14	0.85	2.1	70	6.39	8.4
<i>Agrostis gigantea</i>	--	--	--	14	0.07	1.0	54	3.69	5.7
<i>Parthenium integrifolium</i>	--	--	--	8	0.36	1.0	100	34.31	27.5
<i>Viola sagittata</i>	--	--	--	4	0.31	0.8	98	7.05	10.5
<i>Fragaria virginiana</i>	--	--	--	--	--	--	100	16.63	16.6
<i>Liatris pycnostachya</i>	--	--	--	--	--	--	98	13.04	14.2
<i>Dichanthelium acuminatum</i>	--	--	--	--	--	--	98	8.50	11.4
<i>Desmodium illinoense</i>	--	--	--	--	--	--	94	8.62	11.2
<i>Rudbeckia subtomentosa</i>	--	--	--	--	--	--	68	6.47	8.3
<i>Antennaria neglecta</i>	--	--	--	--	--	--	44	6.59	6.9
<i>Panicum virgatum</i>	--	--	--	--	--	--	46	3.00	4.8
<i>Acalypha gracilens</i>	--	--	--	--	--	--	64	0.61	4.4
<i>Polygala sanguinea</i>	--	--	--	--	--	--	60	0.30	4.0
<i>Hypericum punctatum</i>	--	--	--	--	--	--	50	0.55	3.4
<i>Solidago canadensis</i>	--	--	--	--	--	--	32	1.38	2.9
Others	--	2.76	20.4	--	0.55	6.5	--	3.05	12.8
Totals		65.77	200.0		69.36	200.0		161.73	200.0
Bare ground and litter		28.71			25.35			13.03	

Table 2. Similarity Index of the sand prairies and sedge meadows at the GRSWA.

Communities	Dry Sand Prairie	Dry-mesic Sand Prairie	Mesic Sand Prairie	Wet Sand Prairie	Sedge Meadow (1)
Dry-mesic Sand Prairie	58.82				
Mesic Sand Prairie	26.09	49.38			
Wet Sand Prairie	10.34	11.43	25.00		
Sedge Meadow (1)	00.00	00.00	00.00	27.96	
Sedge Meadow (2)	00.00	3.03	5.49	22.68	18.52

ponds in the small depressions. Mesic sand prairie vegetation occurred on the slopes of the dunes where the soils were comprised of Dakota sandy loam. In contrast, the wet-mesic prairie was on the lower ground between the dunes on Hoopeston fine sandy loam. *Sorghastrum nutans* and *Andropogon gerardii* were the dominant tall grasses, commonly being more than 1.6 m tall. Other common grasses included *Dichanthelium acuminatum*, *Agrostis gigantea*, and *Panicum virgatum* (Table 1). The important native forbs included *Parthenium integrifolium*, *Fragaria virginiana*, *Liatris pycnostachya*, *Desmodium illinoense*, and *Euthamia gymnospermoidea* (Table 1). Based on the Sorenson Index of Similarity, the mesic sand prairie was similar to the dry mesic sand prairies, and has very low similarity to the wet sand prairie and sedge meadows (Table 2). A total of 44 taxa were encountered in the plots, including 3 exotic species. Bare ground and litter averaged 13%. A total of 124 species were observed in the mesic prairie resulting in a FQI of 45.21 and a mean CC of 4.06.

Wet Sand Prairie: A 5-ha wet sand prairie was located along the western and northern edges of a sedge meadow at the southeastern part of the GRSWA (NE1/4 SW1/4 S17 T19N R9E; Fig. 2). The vegetation of this prairie was transitional between the sedge meadow and wet-mesic to mesic sand prairie to the north and west. Here, changes in species composition occurred depending upon slight differences in elevation. *Spartina pectinatus* was the dominant grass, while *Carex haydenii* was the most important sedge. Common forbs included *Helianthus grosseserratus*, *Solidago canadensis*, *Onoclea sensibilis*, *Galium obtusum*, *Hypericum sph-*

erocarpum, and *Silphium integrifolium* all with IVs of 8.0 or higher (Table 3). Based on the Sorenson Index of Similarity, the wet sand prairie was similar to the mesic sand prairies and the sedge meadows, with low similarity to the drier sand communities (Table 2). Within the wet prairie 68 taxa were encountered, including three exotic species, *Poa pratensis* being the most important. Bare ground and litter averaged less than 2%. A total of 102 species were observed in the wet sand prairie for an FQI of 39.11 and a mean CC of 3.87.

Sedge Meadows: Hummocks were present throughout the sedge meadows, their height dependent on the distance from the sedge meadow center, i.e., smaller hummocks near the edge, larger and taller hummocks near the center. One small sedge meadow, covering less than 0.5 ha, occurred in a shallow depression near the southeast corner of GRSWA (NE1/4 SW1/4 S17 T19N R9E; Fig. 2) (sedge meadow East). *Bolboschoenus fluviatilis* was the most important species, followed by *Carex haydenii*. The common species recorded for this sedge meadow included *Thelypteris palustris*, *Onoclea sensibilis*, and *Aster paealtus*. At the south edge of this sedge meadow was a depression that likely represents an old sand pond that became partially filled and no longer holds water year around. *Bolboschoenus fluviatilis* dominated this depression, with *Persicaria amphibia* also common. A total of 44 species were observed in this sedge meadow, yielding a FQI of 30.30 and a mean CC of 4.57.

A 1.5-ha sedge meadow was located at the southeast corner of the marsh (SE1/4 NE1/4 S13 T19N R8E; Fig. 2) (sedge meadow West). In 2002 this sedge meadow was dominated by

Table 3. Frequency (%), mean cover (% of total cover), and importance value (IV) of the ground layer species (with IVs >2.0) encountered in late summer of 2006 in a wet sand prairie and an adjacent sedge meadow (sedge meadow East), Green River State Wildlife Area, Lee County, Illinois. (n = 50) (*exotic species)

Species	Wet Sand Prairie			Sedge Meadow East			
	Freq.	%	Mean Cover	IV	Freq.	%	Mean Cover
<i>Spartina pectinata</i>	50	23.75	18.8	--	--	--	--
<i>Helianthus grosseserratus</i>	96	13.57	14.9	--	--	--	--
<i>Solidago canadensis</i>	72	15.03	14.3	--	--	--	--
<i>Carex haydenii</i>	100	8.23	11.6	52	36.21	38.9	
<i>Onoclea sensibilis</i>	66	8.46	9.6	66	7.01	16.5	
<i>Galium obtusum</i>	82	4.95	8.3	2	0.01	0.3	
<i>Hypericum sphaerocarpum</i>	78	5.15	8.3	--	--	--	--
<i>Silphium integrifolium</i>	48	7.59	8.0	--	--	--	--
<i>Viola pratincola</i>	64	5.90	7.9	--	--	--	--
<i>Stachys pilosa</i>	92	2.62	7.4	--	--	--	--
<i>Thalictrum dasycarpum</i>	52	6.12	7.2	--	--	--	--
<i>Euthamia gymnospermoides</i>	42	5.10	5.9	--	--	--	--
<i>Rudbeckia subtomentosa</i>	38	5.19	5.8	--	--	--	--
<i>Solidago gigantea</i>	56	2.96	5.4	--	--	--	--
<i>Aster paealtus</i>	44	3.81	5.2	48	5.71	12.6	
<i>Pycnanthemum virginianum</i>	42	3.46	4.9	--	--	--	--
<i>Cirsium discolor</i>	38	3.20	4.5	--	--	--	--
<i>Comandra umbellata</i>	26	3.90	4.2	--	--	--	--
<i>Calystegia sepium</i>	38	2.29	3.9	--	--	--	--
<i>Thelypteris palustris</i>	24	3.31	3.7	50	13.85	19.8	
<i>Calamagrostis canadensis</i>	40	1.71	3.6	--	--	--	--
<i>Rubus pensylvanicus</i>	30	1.62	3.0	--	--	--	--
<i>Campanula aparinoides</i>	44	0.32	2.9	16	0.08	2.7	
<i>Muhlenbergia mexicana</i>	32	1.24	2.8	6	0.08	1.1	
<i>Asclepias syriaca</i>	22	1.14	2.1	--	--	--	--
<i>Persicaria amphibia</i>	24	0.46	1.8	50	4.95	12.3	
<i>Bolboschoenus fluvialis</i>	10	0.44	0.9	50	42.51	44.3	
<i>Lycopus uniflorus</i>	10	0.15	0.7	36	0.38	6.1	
<i>Verbena hastata</i>	2	0.06	0.1	42	0.66	7.4	
<i>Boehmeria cylindrica</i>	2	0.01	0.1	60	2.59	12.0	
<i>Scutellaria galericulata</i>	--	--	--	26	0.13	4.3	
* <i>Solanum dulcamara</i>	--	--	--	18	0.82	3.6	
<i>Triadenum fraseri</i>	--	--	--	18	.078	3.5	
* <i>Phalaris arundinacea</i>	--	--	--	14	1.23	3.3	
<i>Bidens coronata</i>	--	--	--	14	0.22	2.5	
<i>Caltha palustris</i>	--	--	--	12	0.26	2.1	
Others	--	11.40	22.2	--	1.06	6.7	
Totals		153.14	200.0		118.54	200.0	
Bare ground and litter		1.50			1.88		

Carex haydenii and *Calamagrostis canadensis*, with *Persicaria coccinea* also common (Table 4). Twenty-nine taxa including three exotic species were encountered in the plots: *Mentha arvensis* was extremely common, followed by *Chenopodium album* and *Persicaria vulgaris*. Though burned in 2005, no peat fires occurred here and the area was not subjected to disking. The three most important species in 2005 maintained their dominance during 2006 and 2007. Eleven additional species were found in the

plots in 2006. By 2007 most of these species were lost or greatly reduced in abundance, and the original dominants of 2002 had regained much of their previous importance. By 2007 two native forbs, *Teucrium canadense* and *Aster paealtus*, had become more obvious (Table 4). In 2002, a total of 42 species were observed in this sedge meadow for an FQI of 21.49 and a mean CC of 3.31.

Marsh: Located along the western edge of the GRSWA, the marsh was divided into five vegetation zones (W1/2 S13 T19N R8E; Fig. 2). Within this 40-ha marsh/sedge meadow complex the vegetation zones were mostly dependent on slight differences in elevation, soils, and past disturbance, particularly drainage attempts and fire frequency, intensity, and time of year. The transitions between the various vegetation zones were abrupt with the edges of the zones being very distinct. Of the 36 species encountered, including several conservative species, only 5 were exotics. The marsh FQI was 18.48 and the mean CC was 3.08. Much of this marsh area was burned in the fall of 2005.

***Phalaris* Vegetation Zone:** The exotic *Phalaris arundinacea* was the dominant species in shallow areas throughout the marsh where water level fluctuations were pronounced (Table 5). This disturbance community occurred in areas where water levels were usually low and flooding was of short duration. This zone was found throughout nearly all of the extensive wetlands at the GRSWA and accounted for nearly half of the marsh area. When surveyed in 2002, *Phalaris arundinacea* dominated, *Persicaria coccinea* was second, and six other species were encountered. In 2006, after the 2005 fire, *P. arundinacea* continued to dominate. Many other species were also present in 2006, but by 2007 many had disappeared (Table 5). Most notable was *Ambrosia artemisiifolia*, which in 2006 was second in importance, but was not found in the plots in 2007.

Salix interior thickets were common at the edge of the marsh as narrow bands at the base of the stabilized dunes. When surveyed in 2002, *Phalaris arundinacea* dominated the ground layer beneath these willow thickets; *Persicaria punctatum* was also common, whereas seven other species were occasionally encountered (Table 6). After the 2005 fire, *P. arundinacea* still dominated; *Urtica gracilis* was second in importance in 2006 but dropped to third by 2007. Five taxa not found in 2002 were encountered in 2006, and the number of new species had increased to 14 by 2007.

An extensive *Phalaris arundinacea* population occurred in a shallow depression near the middle of the GRSWA and close to the office building (SW1/4 NE1/4 S18 T19N R9E). During the 2005 fire, this entire area burned and extensive peat fires destroyed much of the peat; the depression was flooded and disked

in efforts to control the fires. *Phalaris arundinacea* was not recorded in any of the plots when the site was surveyed in 2006. Thirteen native species were present, although the exotic *Circium arvense* was the dominant taxon (Table 7). Other relatively important species included the native taxa *Oenothera biennis*, *Verbena hastata*, and *Persicaria punctata* along with the exotic *Chenopodium album*. By 2007 *P. arundinacea* had returned, *Cirsium arvense* had nearly disappeared and though many native weedy species had invaded, extensive areas of bare ground were present (Table 7).

***Typha/Persicaria* Vegetation Zone:** Scattered throughout the marsh in 2002 were extensive areas of *Typha latifolia* (Table 8). *Persicaria cooccinea* and *Carex lacustris* were common among the cattails. Many other species were occasionally encountered, although none were very important, as indicated by low mean cover. *Typha latifolia* nearly disappeared following the fire, before increasing in importance in 2007 (Table 8). *Phalaris arundinacea* increased between 2005 and 2006, and by 2007 was the dominant species present. Fourteen additional species were recorded in these plots in 2006, whereas many had disappeared by 2007.

One extensive *Typha latifolia* population of 16 ha in size occurred next to the road at the western edge of the marsh, separated from the rest of the marsh by a narrow sand ridge. During the 2005 fire, much of this area burned and the fire destroyed extensive areas of peat, the fires smoldering for a few days. The depression was intentionally flooded and disked. Though the dominant species before the 2005 fire, *T. latifolia* was uncommon in 2006, but increased significantly in 2007 (Table 9). *Phalaris arundinacea*, which was rarely encountered before the 2005 fire, was the dominant species in 2006 and 2007.

***Bolboschoenus fluvialis* Vegetation Zone:** *Bolboschoenus fluvialis* was the dominant species in an area of about 1.2 ha (Table 10). *Persicaria coccinea*, *Sparganium eurycarpum*, and *Urtica gracilis* were common under the river bulrush. Only five species were found in the plots and no exotic species were encountered in 2002 (Table 10). After the 2005 fire, *B. fluvialis* initially decreased and then increased in importance. Thirteen additional species were recorded in these plots in 2006, although many had disappeared by 2007. By 2007, *Persicaria coccinea* had recovered, *Sparganium eury-*

Table 4. Frequency (%), mean cover (% of total cover), and importance value (IV) of the ground layer species encountered in late summer of 2002 and again in 2006 and 2007 in a sedge meadow (sedge meadow West) at the western edge of the Green River State Wildlife Area, Lee County, Illinois. (n=50) (*exotic species)

Species	Summer 2002			Summer 2006			Summer 2007		
	Freq. %	Mean Cover	IV	Freq. %	Mean Cover	IV	Freq. %	Mean Cover	IV
<i>Carex haydenii</i>	100	30.93	43.7	100	43.09	38.9	96	43.85	43.9
<i>Calamagrostis canadensis</i>	100	29.88	42.7	96	29.32	29.3	100	52.80	50.4
<i>Persicaria coccinea</i>	52	17.27	24.0	34	9.01	9.4	56	16.92	19.8
* <i>Mentha arvensis</i>	72	5.18	15.0	38	1.08	4.5	20	1.12	3.8
<i>Eupatorium maculatum</i>	56	7.06	14.6	28	1.56	3.9	10	0.73	2.1
<i>Persicaria punctata</i>	72	1.40	11.3	64	1.11	7.0	44	0.62	7.2
<i>Lycopus uniflorus</i>	58	2.31	10.3	62	1.36	7.0	22	0.75	3.9
<i>Verbena hastata</i>	28	2.04	5.9	2	0.01	0.2	16	0.23	2.7
<i>Scutellaria galericulata</i>	24	0.76	4.1	10	0.10	1.1	10	0.15	1.6
<i>Helianthus grosseserratus</i>	20	1.27	4.0	84	17.40	20.0	16	0.18	2.6
<i>Teucrium canadense</i>	22	0.60	3.7	82	6.15	12.3	42	0.95	7.1
<i>Lycopus americanus</i>	16	0.67	2.8	18	0.44	2.1	8	0.48	1.5
<i>Polygonum ramosissimum</i>	14	0.46	2.5	40	2.20	5.5	20	0.10	3.2
<i>Aster puniceus</i>	12	0.60	2.3	36	2.47	5.3	14	0.56	2.6
<i>Ambrosia artemisiifolia</i>	10	0.49	1.9	50	11.47	12.6	10	0.10	1.6
<i>Stachys pilosa</i>	8	0.48	1.6	28	4.62	5.9	--	--	--
<i>Rumex orbiculatus</i>	8	0.43	1.5	4	0.02	0.4	2	0.30	0.5
<i>Asclepias incarnata</i>	8	0.14	1.2	--	--	--	2	0.01	0.3
<i>Galium obtusum</i>	6	0.42	1.2	4	0.60	0.8	2	0.01	0.3
<i>Aster paealtus</i>	4	0.36	0.9	40	5.86	7.9	86	26.43	30.8
<i>Epilobium coloratum</i>	4	0.36	0.9	--	--	--	--	--	--
<i>Solidago gigantea</i>	4	0.31	0.9	50	6.96	9.6	8	0.24	1.4
<i>Cardamine pensylvanica</i>	6	0.03	0.8	2	0.01	0.2	8	0.04	1.2
<i>Acalypha rhomboidea</i>	2	0.06	0.4	2	0.01	0.2	2	0.01	0.3
<i>Eleocharis verrucosa</i>	2	0.06	0.4	--	--	--	--	--	--
<i>Geum laciniatum</i>	2	0.06	0.4	--	--	--	--	--	--
<i>Lathyrus palustris</i>	2	0.06	0.4	--	--	--	12	1.03	2.7
* <i>Chenopodium album</i>	2	0.01	0.3	44	1.21	5.1	--	--	--
* <i>Persicaria vulgaris</i>	2	0.01	0.3	--	--	--	--	--	--
* <i>Potentilla norvegica</i>	--	--	--	38	0.24	4.0	4	0.02	0.6
<i>Cirsium discolor</i>	--	--	--	20	0.35	2.2	2	0.01	0.3
<i>Solidago canadensis</i>	--	--	--	4	1.50	1.4	4	0.07	0.6
<i>Lactuca canadensis</i>	--	--	--	10	0.10	1.1	--	--	--
* <i>Cirsium arvense</i>	--	--	--	4	0.12	0.5	--	--	--
<i>Persicaria pensylvanica</i>	--	--	--	4	0.02	0.4	--	--	--
* <i>Trifolium repens</i>	--	--	--	4	0.02	0.4	--	--	--
<i>Hackelia virginiana</i>	--	--	--	2	0.06	0.2	--	--	--
<i>Helenium autumnale</i>	--	--	--	2	0.06	0.2	--	--	--
<i>Solanum ptychanthum</i>	--	--	--	2	0.01	0.2	--	--	--
<i>Typha latifolia</i>	--	--	--	2	0.01	0.2	16	0.96	3.1
* <i>Phalaris arundinacea</i>	--	--	--	--	--	--	12	1.77	3.0
<i>Eupatorium perfoliatum</i>	--	--	--	--	--	--	2	0.01	0.3
<i>Iris shrevei</i>	--	--	--	--	--	--	2	0.01	0.3
<i>Lysimachia thyrsiflora</i>	--	--	--	--	--	--	2	0.06	0.3
Totals		103.71	200.0		148.55	200.0		150.52	200.0
Bare ground and litter		1.20			3.65			2.13	

carpum was still recovering, whereas *Urtica gracilis* was not recorded.

***Sparganium eurycarpum* Vegetation Zone:** A few small areas of ≤ 0.5 ha were dominated by *Sparganium euryocarpum* (Table 11). *Persicaria coccinea* was also important followed by *Urtica gracilis*. Only eight species were found in the plots and the exotic *Phalaris arundinacea* was rarely encountered. After the 2005 fire, *S. eurycarpum* was absent from the plots and by 2007 was still uncommon. In contrast, *Persicaria coccinea* increased in importance in 2006 and again in 2007. Thirteen additional species were recorded in these plots in 2006, whereas some were absent in 2007.

***Carex lacustris/Persicaria coccinea* Vegetation Zone:** Located next to the sedge meadow in the southeastern part of the marsh, this zone covered approximately 5 to 6 ha. The dominant species, *Carex lacustris*, *Persicaria coccinea*, and *Calamagrostis canadensis*, far exceed the importance of the other species present (Table 12). Thirteen species were encountered in the

plots with more than half having IVs of less than 1.5. Though burned in 2005, no peat fires occurred and the area was not subjected to disking. During the 2006 and 2007 surveys, the three dominant species maintained their importance. Seventeen additional species were found in the plots in 2006, including the native *Ambrosia artemisiifolia* and exotic *Chenopodium album*. By 2007 most of these species were absent or greatly reduced in abundance, and the original dominants of 2002 had regained much of their previous importance. By 2007 two native prairie forbs, *Teucrium canadense* and *Aster paealtus*, became much more abundant (Table 12).

Sand Pond: Scattered through the lowlands of the GRSWA were a few small sand ponds, none more than 55 m across. The vegetation surrounding these ponds varied extensively. Most ponds were located where *Phalaris arundinacea* dominated the pond margins with few other species being encountered. Around a few

Table 5. Frequency (%), mean cover (% of total cover), and importance value (IV) of the ground layer species encountered in late summer of 2002 and again in 2006 and 2007 in a *Phalaris arundinacea* vegetation zone that is not shaded in the marsh at the western edge of the Green River State Wildlife Area, Lee County, Illinois. (n=50) (*exotic species)

Species	Summer 2002			Summer 2006			Summer 2007		
	Freq. %	Mean Cover	IV	Freq. %	Mean Cover	IV	Freq. %	Mean Cover	IV
* <i>Phalaris arundinacea</i>	100	79.05	130.1	100	84.55	117.1	100	83.30	142.4
<i>Persicaria coccinea</i>	80	8.17	44.3	66	7.45	28.5	60	7.27	40.2
<i>Leersia oryzoides</i>	20	1.94	10.9	--	--	--	--	--	--
<i>Iris shrevei</i>	16	1.63	8.9	4	0.07	1.4	8	1.41	5.8
<i>Typha latifolia</i>	4	0.12	1.9	--	--	--	--	--	--
<i>Hibiscus laevis</i>	2	0.75	1.7	--	--	--	--	--	--
<i>Sium suave</i>	2	0.30	1.2	--	--	--	--	--	--
* <i>Cirsium arvense</i>	2	0.06	1.0	4	0.02	1.3	--	--	--
<i>Ambrosia artemisiifolia</i>	--	--	--	84	4.99	31.8	--	--	--
<i>Rubus pensylvanicus</i>	--	--	--	12	1.56	5.4	10	1.95	7.5
<i>Scirpus cyperinus</i>	--	--	--	6	0.08	2.0	--	--	--
<i>Persicaria punctata</i>	--	--	--	6	0.03	1.9	2	0.01	1.1
* <i>Sida spinosa</i>	--	--	--	6	0.03	1.9	--	--	--
<i>Stachys pilosa</i>	--	--	--	4	0.07	1.4	--	--	--
<i>Teucrium canadense</i>	--	--	--	4	0.12	1.4	--	--	--
<i>Verbena hastata</i>	--	--	--	4	0.02	1.3	--	--	--
<i>Calamagrostis canadensis</i>	--	--	--	2	0.30	0.9	2	0.75	1.9
<i>Ambrosia trifida</i>	--	--	--	2	0.06	0.7	--	--	--
<i>Carex lacustris</i>	--	--	--	2	0.01	0.6	2	0.01	1.1
<i>Hackelia virginiana</i>	--	--	--	2	0.01	0.6	--	--	--
<i>Solanum ptychanthum</i>	--	--	--	2	0.01	0.6	--	--	--
* <i>Verbascum thapsus</i>	--	--	--	2	0.01	0.6	--	--	--
<i>Vitis riparia</i>	--	--	--	2	0.01	0.6	--	--	--
Totals		92.02	200.0		99.40	200.0		94.70	200.0
Bare ground and litter		10.61			5.76			6.08	

ponds, however, wet to wet-mesic sand prairie vegetation dominated depending on the steepness of the shoreline. No high-quality sand ponds were encountered during this study.

Sand Forest: Both lowland and upland forests were located at GRSWA (Fig. 2). The lowland forests were dominated by *Acer saccharinum* with a few subdominant species including *Prunus serotina*, *Populus deltoides*, *Juglans nigra*, *Acer negundo*, *Salix nigra*, and *Fraxinus pennsylvanica* (Sites 1, 2, 3, and 4, Table 13). In these forests *Acer saccharinum* was consistently of highest importance, highest density, and of relatively large size. In contrast, the upland forests where commonly dominated by *Prunus serotina* along with the exotic species *Morus alba* or *Robinia pseudoacacia* and some of the lowland forest species (Sites 5 and 6, Table 13). In both forest types the woody understory was dense, with many native and

exotic trees and shrubs common. Overall, woody seedling densities averaged between 6,000 and 16,000 stems/ha, small saplings averaged between 3,200 and 6,850 stems/ha, while large saplings were not common with an average between 0 and 740 stems/ha. The most abundant understory shrubs were mostly exotic species with *Elaeagnus umbellata*, *Lonicera maackii*, *Lonicera x bella*, *Rhamnus cathartica*, and *Rosa multiflora* common.

The ground layer in these six forest sites was similar. In addition to the numerous woody tree seedlings and shrub in the ground layer, many herbaceous species were common. Generally native herbs dominated, with *Ageratina altissima*, *Antennaria virginianum*, *Boehmeria cylindrica*, *Cryptotaenia canadensis*, *Geum canadense*, *Osmorhiza sp.*, *Phytolacca americana*, *Solidago canadensis*, and *S. gigantea* being the most common taxa. A few exotic herbs such as *Alliaria petiolata*, *Bromus inermis*, *Fallopia convolvulus*,

Table 6. Frequency (%), mean cover (% of total cover), and importance value (IV) of the ground layer species encountered in late summer of 2002 and again in 2006 and 2007 in a *Phalaris arundinacea* vegetation zone community that is shaded under a thicket of *Salix interior* in the marsh at the western edge of the Green River State Wildlife Area, Lee County, Illinois. (n=50). (*exotic species)

Species	Summer 2002			Summer 2006			Summer 2007		
	Freq. %	Mean Cover	IV	Freq. %	Mean Cover	IV	Freq. %	Mean Cover	IV
* <i>Phalaris arundinacea</i>	100	59.10	146.3	100	73.77	136.9	100	48.05	97.2
<i>Persicaria punctata</i>	48	1.24	26.5	14	1.38	9.3	50	6.56	23.4
<i>Urtica gracilis</i>	14	0.12	7.3	38	7.71	29.6	42	3.24	16.4
<i>Persicaria coccinea</i>	10	0.78	6.4	--	--	--	2	0.30	1.0
<i>Carex lacustris</i>	10	0.54	6.0	--	--	--	--	--	--
<i>Scutellaria lateriflora</i>	6	0.13	3.3	--	--	--	--	--	--
<i>Pilea pumila</i>	4	0.02	2.1	--	--	--	24	2.51	10.3
<i>Vitis riparia</i>	2	0.06	1.1	--	--	--	2	0.06	0.7
<i>Phytolacca americana</i>	2	0.01	1.0	4	1.05	3.4	6	0.08	1.8
<i>Fallopia scandens</i>	--	--	--	16	6.05	15.6	12	2.01	6.2
<i>Persicaria pensylvanica</i>	--	--	--	2	0.30	1.4	40	3.07	15.4
<i>Rubus occidentalis</i>	--	--	--	2	0.30	1.4	--	--	--
* <i>Silene pratensis</i>	--	--	--	2	0.06	1.2	--	--	--
<i>Solanum ptychanthum</i>	--	--	--	2	0.06	1.2	6	0.03	1.8
<i>Lemna minor</i>	--	--	--	--	--	--	32	1.34	10.9
<i>Salix nigra</i>	--	--	--	--	--	--	10	0.34	3.3
* <i>Alliaria petiolata</i>	--	--	--	--	--	--	8	0.67	3.2
<i>Boehmeria cylindrica</i>	--	--	--	--	--	--	8	0.14	2.4
<i>Cuscuta gronovii</i>	--	--	--	--	--	--	4	0.07	1.1
<i>Rorippa palustris</i>	--	--	--	--	--	--	4	0.07	1.1
<i>Aster puniceus</i>	--	--	--	--	--	--	2	0.30	1.0
<i>Typha latifolia</i>	--	--	--	--	--	--	2	0.30	1.0
<i>Cirsium discolor</i>	--	--	--	--	--	--	2	0.01	0.6
<i>Geum canadense</i>	--	--	--	--	--	--	2	0.01	0.6
* <i>Persicaria vulgaris</i>	--	--	--	--	--	--	2	0.01	0.6
Totals		62.00	200.0		90.68	200.0		69.17	200.0
Bare ground and litter		34.02			4.42			34.20	

and *Phalaris arundinacea* sometimes dominated.

Woody encroachment at the GRSWA had increased dramatically, based on the analysis of aerial photographs. In 1939, one year after the initial purchase of the land for the GRSWA, approximately 47.5 ha (4.6% cover) were covered by trees and large shrubs. The extent of the forested areas had increased to 72.2 ha (7% cover) by 1951, 184.9 ha (17.8% cover) in 1970, and 294.6 ha (29.4% cover) in 1988. Woody encroachment was most obvious along many of the original hedge rows and where pine plantations were introduced soon after the site was purchased.

In 2001 most of the forests at the GRSWA were clear-cut. Two of these resulting successional areas, a lowland and an upland site, were surveyed in 2002, 2003, and 2006. Of 47 taxa

recorded in 2002, *Phalaris arundinacea* and *Persicaria pensylvanica* dominated the lowland site (Table 14). In 2003, *P. arundinacea* continued to dominate with *Persicaria pensylvanica*, *Conyza canadensis*, *Potentilla norvegica*, and *Populus deltoides* seedlings important. *Phalaris arundinacea* dominated during the 2006 survey, whereas *Solidago canadensis*, *Persicaria pensylvanica*, *Lactuca serriola*, and *Chenopodium album* were among the most important of 58 species encountered (Table 14). Throughout the survey, *P. arundinacea* and *Persicaria pensylvanica* remained dominant members of the lowland community. Overall, 17 species were recorded in all 3 years of the study, with 23 taxa restricted to 2006, 20 found only in 2003, and 15 restricted to 2002; 28 exotic species were recorded in the lowland plots.

Table 7. Frequency (%), mean cover (% of total cover), and importance value (IV) of the ground layer species encountered in late summer of 2006 and 2007 in a marsh that had been dominated by *Phalaris arundinacea* prior to a fire in late 2005, Green River State Wildlife Area, Lee County, Illinois. (n=50)
(*exotic species)

Species	Summer 2006			Summer 2007		
	Freq. %	Mean Cover	IV	Freq. %	Mean Cover	IV
* <i>Cirsium arvense</i>	100	63.00	123.8	2	0.01	0.9
<i>Oenothera biennis</i>	20	3.45	13.5	--	--	--
* <i>Chenopodium album</i>	20	3.00	12.9	--	--	--
<i>Verbena hastata</i>	18	2.41	11.2	--	--	--
<i>Persicaria punctata</i>	16	2.85	10.8	78	11.93	91.0
<i>Amaranthus tuberculatus</i>	12	2.70	8.8	--	--	--
<i>Cycloloma atriplicifolium</i>	8	0.96	4.9	--	--	--
<i>Calamagrostis canadensis</i>	6	0.90	3.9	14	4.74	28.8
<i>Solanum ptychanthum</i>	6	0.03	2.8	--	--	--
<i>Ambrosia artemisiifolia</i>	2	0.30	1.3	--	--	--
<i>Aster praealtus</i>	2	0.30	1.3	22	0.50	12.0
<i>Euthamia graminifolia</i>	2	0.30	1.3	--	--	--
<i>Persicaria pensylvanica</i>	2	0.30	1.3	40	1.33	23.8
<i>Solidago canadensis</i>	2	0.30	1.3	--	--	--
<i>Carex haydenii</i>	2	0.06	0.9	--	--	--
* <i>Phalaris arundinacea</i>	--	--	--	8	1.33	9.9
<i>Persicaria lapathifolia</i>	--	--	--	6	0.18	3.5
<i>Typha latifolia</i>	--	--	--	14	0.17	6.9
<i>Salix nigra</i>	--	--	--	12	0.06	5.5
<i>Carex lacustris</i>	--	--	--	6	0.42	4.6
* <i>Mentha arvensis</i>	--	--	--	6	0.03	2.7
<i>Persicaria amphibium</i>	--	--	--	4	0.07	2.0
<i>Cardamine pensylvanica</i>	--	--	--	4	0.02	1.8
* <i>Persicaria vulgaris</i>	--	--	--	4	0.02	1.8
<i>Salix interior</i>	--	--	--	4	0.02	1.8
* <i>Setaria faberi</i>	--	--	--	2	0.06	1.2
<i>Populus deltoides</i>	--	--	--	2	0.01	0.9
* <i>Potentilla norvegica</i>	--	--	--	2	0.01	0.9
Totals		80.86	200.0		20.91	200.0
Bare ground and litter		22.12			71.52	

In 2002 *Phytolacca americana* dominated the upland site, with *Solanum ptychanthum*, *Chenopodium album*, *Lonicera maackii*, and *Cyperus schweinitzii* following in importance (Table 15). By 2003 *Conyza canadensis* dominated, followed by *Lonicera maackii*, *Verbascum thapsus*, and *Cyperus lupulinus*. In 2006 *Rubus pensylvanicus*, *Verbascum thapsus*, *Chenopodium album*, and *Lonicera maackii* were the important taxa. The number of taxa recorded in the plots varied from 41 to 48, including 21 exotic species.

DISCUSSION

Exotic Species: The sand prairie communities at the GRSWA had high species richness, many prairie conservative species, and few exotic taxa. Exotic species were usually present in low numbers, occurred in restricted areas, and were not major community components. Only three exotic species were consistently encountered in the plots of the upland sand prairies. These species, *Achillea millefolium*, *Rumex acetosella* and *Poa pratensis*, were mostly localized, and though sometimes recorded in high frequencies, they had low densities. In the wet sand prairie

Table 8. Frequency (%), mean cover (% of total cover), and importance value (IV) of the ground layer species encountered in late summer of 2002 and again in 2006 and 2007 in a *Typha latifolia* vegetation zone in the marsh at the western edge of the Green River State Wildlife Area, Lee County, Illinois. (n=50) (*exotic species)

Species	Summer 2002			Summer 2006			Summer 2007		
	Freq. %	Mean Cover	IV	Freq. %	Mean Cover	IV	Freq. %	Mean Cover	IV
<i>Typha latifolia</i>	100	56.15	86.7	6	0.08	0.9	42	4.33	16.1
<i>Persicaria coccinea</i>	88	10.99	32.0	86	8.26	18.9	92	16.36	42.3
<i>Carex lacustris</i>	44	15.68	27.8	44	7.67	12.4	46	14.75	27.6
<i>Rorippa palustris</i>	44	1.06	10.9	--	--	--	--	--	--
* <i>Phalaris arundinacea</i>	34	1.82	9.6	92	80.11	77.8	94	62.07	88.4
* <i>Potentilla norvegica</i>	32	0.16	7.2	28	0.29	4.2	--	--	--
<i>Urtica gracilis</i>	32	0.16	7.2	26	1.69	5.1	--	--	--
<i>Cardamine pensylvanica</i>	22	0.16	5.1	14	0.12	2.1	--	--	--
<i>Amaranthus hybridus</i>	16	0.08	3.6	2	0.01	0.3	--	--	--
* <i>Mentha arvensis</i>	14	0.12	3.3	62	4.06	12.1	4	0.02	1.0
<i>Sparganium eurycarpum</i>	12	0.16	2.8	--	--	--	--	--	--
<i>Solanum ptycanthum</i>	6	0.03	1.3	6	0.3	0.8	--	--	--
* <i>Persicaria vulgaris</i>	4	0.02	0.9	4	0.07	0.7	2	0.06	0.7
<i>Celtis occidentalis</i>	2	0.01	0.4	--	--	--	--	--	--
<i>Erechtites hieracifolia</i>	2	0.01	0.4	--	--	--	--	--	--
<i>Phytolacca americana</i>	2	0.01	0.4	--	--	--	--	--	--
<i>Persicaria punctata</i>	2	0.01	0.4	80	2.16	13.0	28	0.73	8.6
* <i>Chenopodium album</i>	--	--	--	78	2.54	13.2	--	--	--
<i>Ambrosia artemisiifolia</i>	--	--	--	48	6.03	11.7	--	--	--
<i>Aster paealtus</i>	--	--	--	28	5.28	8.3	6	0.08	1.8
* <i>Cirsium arvense</i>	--	--	--	36	1.60	6.4	--	--	--
<i>Persicaria pensylvanica</i>	--	--	--	30	2.20	6.1	16	0.62	5.1
<i>Cirsium discolor</i>	--	--	--	8	0.33	1.4	--	--	--
<i>Hackelia virginiana</i>	--	--	--	6	0.37	1.1	18	1.26	6.4
<i>Bolboschoenus fluviatilis</i>	--	--	--	4	0.12	0.7	--	--	--
<i>Cuscuta gronovii</i>	--	--	--	4	0.12	0.7	--	--	--
<i>Parietaria pensylvanica</i>	--	--	--	4	0.12	0.7	--	--	--
<i>Solidago gigantea</i>	--	--	--	2	0.30	0.5	--	--	--
<i>Alliaria petiolata</i>	--	--	--	2	0.01	0.3	--	--	--
<i>Solidago canadensis</i>	--	--	--	2	0.06	0.3	--	--	--
<i>Stachys pilosa</i>	--	--	--	2	0.01	0.3	--	--	--
<i>Cicuta maculata</i>	--	--	--	--	--	--	2	0.06	0.7
* <i>Persicaria lapathifolia</i>	--	--	--	--	--	--	2	0.06	0.7
<i>Sium suave</i>	--	--	--	--	--	--	2	0.01	0.6
Totals		86.63	200.0		123.64	200.0		100.41	200.0
Bare ground and litter		11.26			1.49			13.37	

Table 9. Frequency (%), mean cover (% of total cover), and importance value (IV) of the ground layer species encountered in late summer of 2006 and 2007 in a marsh area that had been dominated by *Typha latifolia* prior to a fire in late 2005, Green River State Wildlife Area, Lee County, Illinois. (n=50) (*exotic species)

Species	Summer 2006			Summer 2007		
	Freq. %	Mean Cover	IV	Freq. %	Mean Cover	IV
* <i>Phalaris arundinacea</i>	100	80.25	132.5	92	18.27	65.5
<i>Persicaria pensylvanica</i>	40	7.31	26.8	32	0.78	9.8
<i>Persicaria punctata</i>	38	3.78	22.1	76	4.66	29.8
* <i>Cirsium arvense</i>	8	0.96	4.8	--	--	--
<i>Ambrosia artemisiifolia</i>	8	0.72	4.6	--	--	--
<i>Typha latifolia</i>	8	0.72	4.6	58	11.64	41.6
<i>Cuscuta gronvii</i>	4	0.36	2.3	--	--	--
<i>Persicaria lapathifolia</i>	4	0.36	2.3	8	0.04	2.1
<i>Bolboschoenus fluvialis</i>	--	--	--	24	5.48	18.7
<i>Lemna minor</i>	--	--	--	60	0.30	15.7
<i>Persicaria amphibium</i>	--	--	--	40	0.49	11.1
<i>Typha angustifolia</i>	--	--	--	4	1.05	3.5
<i>Schoenoplectus tabernaemontani</i>	--	--	--	2	0.30	1.2
<i>Cardamine pensylvanica</i>	--	--	--	2	0.01	0.5
* <i>Mentha arvensis</i>	--	--	--	2	0.01	0.5
Totals		94.46	200.0		43.03	200.0
Bare ground and litter		6.97			47.55	

Table 10. Frequency (%), mean cover (% of total cover), and importance value (IV) of the ground layer species encountered in late summer of 2002 and again in 2006 and 2007 in a *Bolboschoenus fluvialis* vegetation zone in the marsh at the western edge of the Green River State Wildlife Area, Lee County, Illinois. (n=50) (*exotic species)

Species	Summer 2002			Summer 2006			Summer 2007		
	Freq. %	Mean Cover	IV	Freq. %	Mean Cover	IV	Freq. %	Mean Cover	IV
<i>Bolboschoenus fluvialis</i>	100	69.15	109.7	6	0.42	1.5	100	43.95	68.0
<i>Persicaria coccinea</i>	98	14.91	47.0	68	12.85	24.6	98	26.40	50.0
<i>Sparganium eurycarpum</i>	62	2.18	21.4	--	--	--	26	1.11	7.4
<i>Urtica gracilis</i>	66	1.08	21.3	42	17.02	23.4	--	--	--
<i>Rorippa palustris</i>	2	0.01	0.6	4	0.02	0.8	--	--	--
* <i>Persicaria vulgaris</i>	--	--	--	68	29.04	39.3	2	0.01	0.5
* <i>Chenopodium album</i>	--	--	--	90	5.25	21.8	--	--	--
<i>Persicaria pensylvanica</i>	--	--	--	34	13.86	19.0	70	4.01	21.0
<i>Cuscuta gronvii</i>	--	--	--	62	6.27	17.4	--	--	--
<i>Persicaria punctata</i>	--	--	--	60	6.04	16.9	92	18.76	40.9
* <i>Mentha arvensis</i>	--	--	--	40	9.91	16.6	--	--	--
<i>Persicaria lapathifolia</i>	--	--	--	12	4.41	6.3	--	--	--
<i>Ambrosia artemisiifolia</i>	--	--	--	18	2.70	5.9	--	--	--
* <i>Phalaris arundinacea</i>	--	--	--	10	1.23	3.0	14	6.30	9.7
<i>Amaranthus tuberculatus</i>	--	--	--	6	0.42	1.5	--	--	--
<i>Erechtites hieracifolia</i>	--	--	--	4	0.12	0.8	--	--	--
<i>Aster paealtus</i>	--	--	--	2	0.30	0.7	--	--	--
<i>Cirsium discolor</i>	--	--	--	2	0.06	0.5	--	--	--
<i>Cicuta maculata</i>	--	--	--	--	--	--	2	0.01	0.5
<i>Teucrium canadense</i>	--	--	--	--	--	--	8	0.14	2.0
Totals		87.33	200.0		109.92	200.0		100.69	200.0
Bare ground and litter		11.24			6.60			10.10	

the exotic species included *Poa pratensis*, *Lactuca serriola*, and *Rumex crispus*, all with very low numbers. In the sedge meadows four exotic species were recorded with *Mentha arvensis* being the most common. *Phalaris arundinacea* was the dominant species throughout most of the GRSWA lowlands, particularly the marsh. The abundance of *Phalaris arundinacea* at GRSWA is an indication of past disturbances, particularly the fluctuation of water levels due to attempts to drain these lowlands. Water table fluctuations resulting from large amounts of ground water being removed for irrigation has exacerbated the problem.

The exotic species *Morus alba* and *Robinia pseudoacacia* dominated the upland sand forests at GRSWA. These disturbed, poor-quality forests had become established due to the lack of fire. Associated shrubs on these wooded sites included the exotics *Elaeagnus umbellata*, *Lonicera maackii*, *L. x bella*, *Rhamnus cathartica*, and *Rosa multiflora*, which in many areas created impenetrable thickets. When these forested areas were clear-cut in 2001, no slash was

left on the ground, and the woody understory was removed. All that was left were stumps that were cut very close to the ground, along with mostly bare sand and some areas covered with a layer of litter. A majority of the species colonizing these areas were exotic and native weedy species.

Endangered Species: Few endangered and threatened species were encountered in GRSWA, probably the result of poor management prior to 1993. *Botrychium matricariifolium* was the only endangered species found at the GRSWA, occurring at the edge of a mesic sand prairie beneath individuals of *Lonicera maackii*. Three threatened species were found: *Lechea intermedia*, *Orobanche ludoviciana*, and *Platanthera flava* var. *helbiola* (Herkert and Ebinger 2002, Illinois Endangered Species Protection Board 2005).

Dry Sand Prairie: The dry sand prairie at GRSWA was similar to the one located at Foley Nature Preserve (FNP; McFall and Karnes

Table 11. Frequency (%), mean cover (% of total cover), and importance value (IV) of the ground layer species encountered in late summer of 2002 and again in 2006 and 2007 in a *Sparganium eurycarpum* vegetation zone in the marsh at the western edge of the Green River State Wildlife Area, Lee County, Illinois. (n=50) (*exotic species)

Species	Summer 2002			Summer 2006			Summer 2007		
	Freq. %	Mean Cover	IV	Freq. %	Mean Cover	IV	Freq. %	Mean Cover	IV
<i>Sparganium eurycarpum</i>	100	45.55	91.2	--	--	--	14	0.56	5.4
<i>Persicaria coccinea</i>	100	19.54	53.8	96	33.31	42.9	100	48.73	90.1
<i>Urtica gracilis</i>	84	0.47	22.3	74	18.45	27.2	--	--	--
<i>Schoenoplectus acutus</i>	40	2.25	13.5	--	--	--	--	--	--
<i>Rorippa palustris</i>	44	1.35	13.3	12	0.26	2.2	--	--	--
* <i>Phalaris arundinacea</i>	10	0.05	2.7	2	0.06	0.4	8	1.12	4.0
<i>Amaranthus hybridus</i>	8	0.04	2.1	2	0.01	0.3	--	--	--
* <i>Potentilla norvegica</i>	4	0.02	1.1	6	0.42	1.3	--	--	--
<i>Persicaria pensylvanica</i>	--	--	--	80	24.35	32.9	22	0.70	8.3
* <i>Chenopodium album</i>	--	--	--	94	9.29	22.9	--	--	--
<i>Persicaria punctata</i>	--	--	--	56	9.06	16.6	78	12.70	41.0
* <i>Mentha arvensis</i>	--	--	--	44	6.78	12.7	4	0.02	1.5
<i>Aster paealtus</i>	--	--	--	32	8.05	11.7	2	0.01	0.7
<i>Cuscuta gronovii</i>	--	--	--	38	2.96	8.6	--	--	--
<i>Ambrosia artemisiifolia</i>	--	--	--	24	4.55	7.6	--	--	--
* <i>Cirsium arvense</i>	--	--	--	20	1.80	4.8	--	--	--
<i>Persicaria lapathifolia</i>	--	--	--	12	1.56	3.3	2	0.01	0.7
* <i>Persicaria vulgaris</i>	--	--	--	10	1.26	2.6	4	0.12	1.5
<i>Bolboschoenus fluviatilis</i>	--	--	--	4	0.36	1.0	60	22.95	46.8
<i>Lycopus americanus</i>	--	--	--	2	0.30	0.5	--	--	--
<i>Solidago gigantea</i>	--	--	--	2	0.30	0.5	--	--	--
Totals		69.27	200.0		123.13	200.0		86.92	200.0
Bare ground and litter		25.74			6.75			23.90	

1995, McClain et al. 2003). Located in the extreme western part of Lee County (SW1/4 S7 T20N R8E), this preserve covers the entire ridge and slopes of a small dune, and contains a 2.8-ha dry to dry-mesic sand prairie remnant. *Schizachyrium scoparium* dominated both areas and many forbs were common to both sites. Common forbs at FNP were *Euphorbia corollata*, *Aster ericoides*, *Echinacea pallida*, *Coreopsis palmata*, and *Ambrosia psilostachya*, while

Amorpha canescens was the common shrub. Species diversity at FNP was higher than at the GRSWA, however, and more conservative prairie species were present as indicated by an FQI of 52.98 and a mean CC of 3.96 (McClain et al. 2003) compared to an FQI of 36.16 and a mean CC of 3.73 at GRSWA. This may be the result of an older, more aggressive management program at the former, although disturbance prior to public acquisition was probably more

Table 12. Frequency (%), mean cover (% of total cover), and importance value (IV) of the ground layer species encountered in late summer of 2002 and again in 2006 and 2007 in a *Carex lacustris* vegetation zone in the marsh at the western edge of the Green River State Wildlife Area, Lee County, Illinois. (n=50) (*exotic species)

Species	Summer 2002			Summer 2006			Summer 2007		
	Freq. %	Mean Cover	IV	Freq. %	Mean Cover	IV	Freq. %	Mean Cover	IV
<i>Carex lacustris</i>	100	42.80	75.4	100	29.95	32.4	100	38.85	51.7
<i>Persicaria coccinea</i>	100	36.45	69.1	100	55.40	47.8	100	51.20	61.4
<i>Calamagrostis canadensis</i>	38	18.35	30.8	46	8.10	11.5	42	20.40	24.9
<i>Lysimachia thyrsiflora</i>	18	0.82	6.7	4	0.07	0.6	10	0.05	2.1
<i>Lycopus uniflorus</i>	16	0.52	5.7	6	0.08	0.9	4	0.31	1.1
<i>Persicaria punctata</i>	16	0.23	5.4	16	0.13	2.4	16	0.38	3.7
<i>Scutellaria galericulata</i>	4	0.07	1.4	6	0.08	0.9	--	--	--
<i>Teucrium canadense</i>	4	0.07	1.4	32	1.43	5.5	54	4.06	14.6
<i>Rumex orbiculatus</i>	2	0.30	1.0	--	--	--	2	0.30	0.6
<i>Aster praecaltus</i>	2	0.06	0.8	22	4.83	6.0	30	7.94	12.6
<i>Lycopus americanus</i>	2	0.06	0.8	14	1.09	2.7	2	0.06	0.5
<i>Polygonum ramosissimum</i>	2	0.06	0.8	34	1.05	5.5	44	0.57	9.8
* <i>Mentha arvensis</i>	2	0.01	0.7	20	2.25	4.3	8	0.43	2.0
<i>Ambrosia artemisiifolia</i>	--	--	--	100	38.16	37.3	4	0.02	0.9
* <i>Chenopodium album</i>	--	--	--	84	10.83	18.6	--	--	--
<i>Cirsium discolor</i>	--	--	--	26	1.25	4.5	2	0.01	0.4
<i>Galium obtusum</i>	--	--	--	10	3.56	3.6	--	--	--
<i>Solidago gigantea</i>	--	--	--	10	2.21	2.7	4	0.02	0.9
<i>Ambrosia trifida</i>	--	--	--	10	1.71	2.4	--	--	--
<i>Stachys pilosa</i>	--	--	--	12	1.03	2.3	10	0.10	2.2
<i>Oenothera biennis</i>	--	--	--	10	0.44	1.7	--	--	--
* <i>Potentilla norwegica</i>	--	--	--	10	0.15	1.5	4	0.07	1.0
<i>Physalis subglabrata</i>	--	--	--	6	0.42	1.2	--	--	--
<i>Lathyrus palustris</i>	--	--	--	6	0.13	1.0	2	0.06	0.5
<i>Verbena hastata</i>	--	--	--	4	0.31	0.8	--	--	--
<i>Lactuca canadensis</i>	--	--	--	4	0.12	0.7	2	0.01	0.4
<i>Hackelia virginiana</i>	--	--	--	2	0.01	0.3	--	--	--
* <i>Nepeta cataria</i>	--	--	--	2	0.01	0.3	--	--	--
<i>Solidago canadensis</i>	--	--	--	2	0.06	0.3	--	--	--
* <i>Taraxacum officinale</i>	--	--	--	2	0.01	0.3	--	--	--
<i>Carex haydenii</i>	--	--	--	--	--	--	18	2.46	5.7
<i>Iris shrevesi</i>	--	--	--	--	--	--	2	0.06	0.5
* <i>Phalaris arundinacea</i>	--	--	--	--	--	--	2	0.06	0.5
<i>Asclepias incarnata</i>	--	--	--	--	--	--	2	0.01	0.4
<i>Euthamia graminifolia</i>	--	--	--	--	--	--	2	0.01	0.4
* <i>Morus alba</i>	--	--	--	--	--	--	2	0.01	0.4
<i>Persicaria vulgaris</i>	--	--	--	--	--	--	2	0.01	0.4
<i>Cardamine parviflora</i>	--	--	--	--	--	--	2	0.01	0.4
Totals		99.80	200.0		164.87	200.0		127.4	200.0
Bare ground and litter		1.60			5.14			12.38	

Table 13. Density (stems/ha) of seedlings, saplings, and trees, basal area (m^2/ha); relative values, importance value (IV), and average diameter (cm) of the woody species (>10.0 cm dbh) encountered in six wooded areas, Green River State Wildlife Area, Lee County, Illinois. (*exotic species)

Species	Seedlings	Saplings		Trees #/ha	Basal Area m^2/ha	Rel. Den.	Rel. Dom.	IV	Av. Diam. cm
		Small	Large						
Site # 1									
<i>Acer saccharinum</i>	1500	700	640	765	38.085	89.5	68.9	158.4	22.8
<i>Populus deltoides</i>	--	--	--	30	10.735	3.5	19.4	22.9	65.0
<i>Salix nigra</i>	--	--	--	35	6.010	4.1	10.9	15.0	45.5
<i>Acer negundo</i>	--	--	40	20	0.385	2.3	0.7	3.0	15.1
<i>Prunus serotina</i>	--	--	--	5	0.065	0.6	0.1	0.7	12.7
Others	7000	3300	60	--	--	--	--	--	--
Totals	8500	4000	740	855	55.280	100.0	100.0	200.0	
Site # 2									
<i>Acer saccharinum</i>	--	--	--	295	20.365	67.8	73.9	141.7	27.2
<i>Prunus serotina</i>	500	50	40	100	5.590	23.0	20.3	43.3	24.7
<i>Juglans nigra</i>	--	--	--	20	0.820	4.6	3.0	7.6	21.0
<i>Fraxinus pennsylvanica</i>	--	350	--	20	0.775	4.6	2.8	7.4	20.6
Others	6500	5600	20	--	--	--	--	--	--
Totals	7000	6000	60	435	27.550	100.0	100.0	200.0	
Site # 3									
<i>Acer saccharinum</i>	2000	--	--	225	26.345	52.3	77.4	129.7	35.5
<i>Prunus serotina</i>	500	50	80	100	4.290	23.3	12.6	35.9	21.9
<i>Fraxinus pennsylvanica</i>	--	200	40	25	0.530	5.8	1.6	7.4	15.2
<i>Populus deltoides</i>	--	--	--	10	1.325	2.3	3.9	6.2	41.1
<i>Quercus velutina</i>	--	--	40	20	0.515	4.7	1.5	6.2	17.5
<i>Acer negundo</i>	--	100	--	20	0.375	4.7	1.1	5.8	15.0
* <i>Malcura pomifera</i>	--	--	20	10	0.350	2.3	1.0	3.3	21.1
* <i>Morus alba</i>	--	100	140	10	0.170	2.3	0.5	2.8	14.3
<i>Celtis occidentalis</i>	--	200	20	10	0.120	2.3	0.4	2.7	12.4
Others	13500	6200	--	--	--	--	--	--	--
Totals	16000	6850	340	430	34.020	100.0	100.0	200.0	
Site # 4									
<i>Acer saccharinum</i>	--	100	20	345	24.690	75.0	80.8	155.8	28.0
<i>Prunus serotina</i>	1000	--	--	115	5.885	25.0	19.2	44.2	24.5
Others	5000	3300	--	--	--	--	--	--	--
Totals	6000	3400	20	460	30.575	100.0	100.0	200.0	
Site # 5									
* <i>Morus alba</i>	--	50	260	215	4.330	38.4	13.9	52.3	15.3
<i>Prunus serotina</i>	--	50	--	100	9.605	17.9	30.7	48.6	30.7
<i>Populus deltoides</i>	--	--	--	35	8.180	6.2	26.1	32.3	53.7
<i>Celtis occidentalis</i>	500	50	160	105	1.805	18.8	5.8	24.6	14.1
<i>Juglans nigra</i>	500	--	--	55	2.865	9.8	9.2	19.0	29.2
<i>Acer negundo</i>	--	100	20	40	1.675	7.1	5.4	12.5	20.3
<i>Acer saccharinum</i>	--	--	--	5	2.555	0.9	8.2	9.1	80.7
<i>Quercus velutina</i>	1000	--	20	5	0.215	0.9	0.7	1.6	23.5
Others	4000	5150	--	--	--	--	--	--	--
Totals	6000	5400	460	560	31.230	100.0	100.0	200.0	
Site # 6									
<i>Prunus serotina</i>	1000	--	--	225	15.680	60.0	76.0	136.0	29.0
* <i>Robinia pseudoacacia</i>	10000	2200	--	150	4.960	40.0	24.0	64.0	19.9
Others	4000	1000	--	--	--	--	--	--	--
Totals	15000	3200	--	375	20.640	100.0	100.0	200.0	

important. The low numbers of exotic taxa, along with presence of native and conservative prairie taxa, indicate that both sites were recovering from past disturbances.

The dry sand prairie at GRSWA is also similar to a small prairie remnant at the Richardson Wildlife Foundation (RWF). Located about 13 km east of Amboy, Lee County, Illinois (S13, S14, S3, S24, T20N R11E), the RWF is located near the southwestern edge of what was the Great Inlet Swamp (Killey 1998, Handel et

al. 2003). This swamp covered approximately 12,000 ha, and existed because of the Dewey Dam, a natural limestone obstruction 8 km northeast of the town of Amboy, which prevented channel formation by the Green River (Lyman 1901). In the late 1880s, work began to drain this extensive swamp. Efforts to save the swamp and keep it as a wildlife sanctuary failed, and by 1901 the swamp was gone (McClain 1992, McClain and Ebinger 2000). After drainage most of the Great Inlet Swamp

Table 14. Frequency (%), mean cover (% of total cover), and importance value (IV) of the ground layer species (with IV's >2.0) encountered in 2002, 2003, and 2006 in a successional lowland area cleared of trees in the winter of 2001, Green River State Wildlife Area, Lee County, Illinois. (n=100) (*exotic species)

Species	Summer 2006			Summer 2003			Summer 2002		
	Freq. %	Mean Cover	IV	Freq. %	Mean Cover	IV	Freq. %	Mean Cover	IV
* <i>Phalaris arundinacea</i>	96	28.49	46.0	92	37.49	63.7	76	28.93	52.1
<i>Solidago canadensis</i>	71	15.82	27.6	48	0.89	7.6	--	--	--
<i>Persicaria pensylvanica</i>	71	4.43	13.4	57	4.32	13.5	65	20.52	38.8
* <i>Lactuca serriola</i>	61	4.48	12.4	9	0.17	1.4	--	--	--
* <i>Chenopodium album</i>	79	1.18	10.2	17	0.70	3.3	1	0.15	0.4
<i>Carex cristatella</i>	53	2.28	8.7	--	--	--	--	--	--
<i>Cirsium discolor</i>	45	2.64	8.3	1	0.03	0.1	--	--	--
* <i>Verbascum Thapsus</i>	53	0.61	6.7	7	0.16	1.1	3	0.04	0.6
* <i>Cirsium arvense</i>	28	2.62	6.4	--	--	--	--	--	--
<i>Eupatorium serotinum</i>	40	1.49	6.3	31	1.36	6.0	21	1.20	5.2
<i>Persicaria coccinea</i>	22	2.58	5.7	38	3.48	9.9	26	2.56	7.8
<i>Solidago gigantea</i>	17	2.05	4.5	--	--	--	--	--	--
<i>Ambrosia artemisiifolia</i>	21	1.54	4.2	4	0.59	1.3	--	--	--
<i>Populus deltoides</i>	16	1.95	4.2	40	4.39	11.3	33	2.25	8.6
<i>Oenothera biennis</i>	26	0.62	3.7	--	--	--	1	0.15	0.4
<i>Acalypha rhomboidea</i>	28	0.39	3.6	14	0.15	2.1	--	--	--
* <i>Fallopia convolvulus</i>	27	0.44	3.5	5	0.08	0.8	--	--	--
<i>Stachys pilosa</i>	13	1.11	2.8	5	0.22	1.0	--	--	--
* <i>Morus tatarica</i>	13	0.56	2.1	18	1.05	3.9	21	0.43	4.2
<i>Solanum carolinense</i>	11	0.64	2.0	--	--	--	--	--	--
<i>Solanum ptychanthum</i>	10	0.05	1.2	9	0.10	1.3	9	0.58	2.4
<i>Bidens vulgaris</i>	5	0.08	0.7	7	1.37	2.8	1	0.15	0.4
<i>Phytolacca americana</i>	1	0.38	0.6	3	0.07	0.5	12	0.84	3.1
<i>Carex sp.</i>	2	0.01	0.2	45	1.98	8.7	--	--	--
* <i>Setaria faberi</i>	2	0.01	0.2	15	0.72	3.0	2	0.18	0.6
<i>Conyzza canadensis</i>	--	--	--	57	4.47	13.8	--	--	--
* <i>Potentilla norvegica</i>	--	--	--	42	4.97	12.4	26	0.50	5.1
* <i>Persicaria cespitosa</i>	--	--	--	29	1.29	5.7	30	2.58	8.6
<i>Amaranthus tuberculatus</i>	--	--	--	17	0.11	2.5	--	--	--
* <i>Digitaria sanguinalis</i>	--	--	--	12	0.36	2.1	11	0.33	2.3
<i>Cyperus strigosus</i>	--	--	--	8	0.04	1.2	46	0.48	8.4
<i>Eleocharis ovata</i>	--	--	--	7	0.04	1.0	35	0.23	6.2
<i>Lindernia anagallidea</i>	--	--	--	--	--	--	50	2.49	11.9
<i>Rorippa palustris</i>	--	--	--	--	--	--	23	1.19	6.5
<i>Amaranthus albus</i>	--	--	--	--	--	--	14	2.29	5.5
* <i>Amaranthus hybridus</i>	--	--	--	--	--	--	9	1.80	3.9
<i>Rotala ramosior</i>	--	--	--	--	--	--	13	0.55	2.9
Others	--	4.76	16.8	--	2.49	18.0	--	2.77	14.1
Totals	--	80.57	200.0	--	73.09	200.0	--	73.19	200.0
Average bare ground and litter	--	16.11	--	--	36.44	--	--	30.44	--

was farmed, but many smaller tracts were left for cattle grazing. As of 1999, 15 ha of sand prairie and sedge meadow remnants existed on the RWF.

This dry sand prairie remnant at RWF was more mesic than the dry sand prairie at GRSWA since the dunes in this part of the Green River Lowlands are smaller and the water table is closer to the surface. On this dry sand prairie *Sorgastrum nutans* dominated, followed by *Euthamia graminifolia*, *Schizachyrium scoparium*, *Solidago nemoralis*, *Liatris aspera*, and *Viola sagittata*. Diversity was low, with only 46 species, including the exotic *Rumex acetosella*, *Poa pratensis*, and *Achillea millefolium*, recorded (Handel et al. 2003). The FQI of this

dry sand prairie was 29.28 and the mean CC was 4.18.

Dry-mesic Sand Prairie: *Sorghastrum nutans* was the dominant native grass in the dry-mesic sand prairies at both GRSWA and RWF (Handel et al. 2003). *Andropogon gerardii*, in contrast, was important at GRSWA, but nearly absent at RWF. *Dichanthelium villosissimum*, a low-growing bunch grass, was fifth in importance at GRSWA but was not encountered at RWF. The dominant forbs on the RWF were *Solidago nemoralis*, *Parthenium integrifolium*, and *Euthamia graminifolia*. Only about half of the species were common to both sites; however, RWF was relatively rich in conservative

Table 15. Frequency (%), mean cover (% of total cover), and importance value (IV) of the ground layer species (with IVs >2.0) encountered in 2002, 2003, and 2006 in a successional upland area cleared of trees in the winter of 2001, Green River State Wildlife Area, Lee County, Illinois. (n=100) (*exotic species)

Species	Summer 2006			Summer 2003			Summer 2002		
	Freq. %	Mean Cover	IV	Freq. %	Mean Cover	IV	Freq. %	Mean Cover	IV
<i>Rubus pensylvanicus</i>	55	14.30	29.4	36	2.67	8.5	25	0.82	6.0
* <i>Verbascum Thapsus</i>	62	5.89	17.4	78	5.57	17.9	27	2.96	11.1
* <i>Chenopodium album</i>	65	3.65	14.5	32	0.41	4.6	44	6.12	21.0
* <i>Lonicera maackii</i>	39	5.93	14.4	88	11.02	27.3	60	4.28	19.6
<i>Prunus serotina</i>	29	5.22	11.9	68	1.91	11.3	22	0.31	4.6
<i>Rubus occidentalis</i>	30	4.78	11.4	16	1.20	3.9	3	0.45	1.4
<i>Ambrosia artemisiifolia</i>	43	3.47	11.1	26	1.44	5.3	4	0.60	2.1
* <i>Robinia pseudoacacia</i>	36	3.11	9.7	30	2.20	7.0	23	0.87	5.8
<i>Conyza canadensis</i>	45	2.10	9.3	96	26.50	51.3	5	0.37	1.6
<i>Lactuca canadensis</i>	44	1.04	7.6	--	--	--	3	0.07	0.5
<i>Solidago canadensis</i>	26	2.64	7.6	4	0.07	0.6	2	0.06	0.4
<i>Cyperus lupulinus</i>	44	0.98	7.5	68	3.09	13.0	3	0.04	0.5
* <i>Alliaria petiolata</i>	41	0.87	6.9	--	--	--	41	2.18	11.8
<i>Phytolacca americana</i>	14	2.52	5.8	24	1.29	4.9	83	11.16	38.8
<i>Prunus virginiana</i>	15	2.46	5.8	8	0.33	1.5	17	0.53	4.0
<i>Smilacina stellata</i>	20	0.50	3.4	2	0.06	0.4	2	0.02	0.4
<i>Dichanthelium villosissimum</i>	14	0.54	2.7	4	0.12	0.7	4	0.10	0.9
* <i>Phalaris arundinacea</i>	10	0.64	2.4	8	0.67	2.0	2	0.18	0.7
<i>Solanum carolinense</i>	9	0.73	2.3	8	0.19	1.3	--	--	--
<i>Oxalis stricta</i>	14	0.07	2.0	10	0.05	1.3	1	0.01	0.2
<i>Parthenocissus quinquefolia</i>	8	0.43	1.8	8	0.67	2.0	6	0.30	1.7
<i>Carex molesta</i>	5	0.39	1.3	14	1.09	3.3	--	--	--
<i>Quercus velutina</i>	3	0.45	1.1	14	0.22	2.0	1	0.03	0.3
<i>Dichanthelium oligosanthes</i>	5	0.08	0.8	28	2.29	6.9	7	0.28	1.7
<i>Muhlenbergia schreberi</i>	3	0.02	0.4	12	1.00	3.0	7	0.51	2.2
<i>Solanum ptychanthum</i>	2	0.01	0.3	14	0.17	2.0	67	8.88	31.0
<i>Chenopodium standleyanum</i>	1	0.03	0.2	--	--	--	11	1.23	4.5
<i>Polygala polygama</i>	--	--	--	20	0.54	3.3	10	0.05	1.8
<i>Dichanthelium acuminatum</i>	--	--	--	14	0.80	2.9	6	0.06	1.1
<i>Cyperus schweinitzii</i>	--	--	--	8	0.38	1.6	64	1.36	13.7
Others	--	2.34	11.0	--	1.35	10.2	--	1.11	10.6
Totals	--	65.19	200.0	--	67.30	200.0	--	44.94	200.0
Average bare ground and litter	--	26.68	--	--	31.68	--	--	51.40	--

species that were not found at GRSWA. The FQI was 41.88 and the mean CC was 4.44 at RWF (compared to FQI of 37.77, mean CC of 3.74 at GRSWA).

Mesic Sand Prairie: The mesic to wet-mesic sand prairies at RWF and GRSWA differed in species composition (Handel et al. 2003). On both sites *Sorghastrum nutans* and *Andropogon gerardii* were the dominant tall grasses. Also, at both sites forb diversity was high, but few of the species encountered at the GRSWA were found at RWF, and except for the dominant tall grasses there was almost no similarity between the two sites. The mesic sand prairie at RWF had a higher FQI and mean CC than at GRSWA. Overall, there were fewer native prairie species at GRSWA and most were not conservative species. Past destructive management practices (including food plot plantings, lack of fire, and equestrian use) at GRSWA prior to 1993 were probably responsible for these differences.

Wet Sand Prairie: The only wet sand prairie examined in the Green River Lowlands was associated with a sedge meadow/mesic prairie area at GRSWA. This plant community is similar in species composition to wet “black soil” prairies with *Spartina pectinatus*, *Calamagrostis canadensis*, *Thelypteris palustris* and various *Carex* species common (White and Madany 1978). The wet sand prairie at GRSWA, with 102 taxa, had the highest species diversity of all communities encountered. Many were rare species with very specific habitat requirements, some of which were common throughout the wet prairie.

Sedge Meadow: Sedge meadows are relatively common in the preserves of the Green River Lowlands. Two were studied at GRSWA, whereas three at RWF had earlier been examined (Handel et al. 2003). All were similar in having extensive hummocks of *Carex haydenii*, the dominant species. The species commonly encountered at RWF included *Onoclea sensibilis*, *Thelypteris palustris*, *Calamagrostis canadensis*, *Helianthus grosseserratus*, *Boehmeria cylindrica*, *Solidago gigantea*, and *Galium obtusum*; many of the same species encountered at the GRSWA sedge meadows. The sedge meadows at RWF averaged between 39 and 54 species, compared to 25 to 29

species at GRSWA. The reason for the lower species diversity at the GRSWA is not known, but is undoubtedly related to the nature of past disturbances, and more active management, especially water table manipulation, at RWF.

Marsh: The only marsh examined in the Green River Lowlands, located at the western edge of the GRSWA, was surveyed in 2002, subjected to an uncontrolled burn in 2005, and surveyed again in late summer of 2006 and 2007. During 2002 species diversity was very low, composed mainly of species found in many marsh communities throughout most of Illinois (White and Madany 1978). The first year after the 2005 fire, many native weedy species became important, whereas the original dominant species were either absent or present in low numbers. By 2007 many of these native weedy species were greatly reduced in numbers or were absent altogether, whereas many of the species dominant in 2002 were recovering. One exception was *Sparganium eurycarpum*, which had not recovered by 2007. It appears that this species does not do well after hot fires, many of the rhizomes likely did not survive. Many of the less abundant species that were present in 2002 were not observed in the later surveys as they were never important stand components.

Sand Forest: Based on General Land Office (GLO) survey notes and plats, the pre-settlement sand deposits of the Green River Lowlands were dominated by sand prairies and marshes. The dominant tree on sand dunes was *Quercus velutina*, mostly occurring as scattered individuals on dune ridges and protected sites. These savannas consisted of open-growth trees and ground cover dominated by sand prairie grasses and forbs (Curtis 1959, Bray 1960, Nuzzo 1986, White and Madany 1978). In dry sand savannas the soil lacked a dark A horizon and the ground cover was composed of many prairie species with the dominant bunchgrasses, which were typically less than 1 m tall. These dry sand savannas and forests were associated with dune and swale topography, which probably limited the severity of fires. Common lowland species of the Green River Lowlands were probably *Acer saccharinum*, *Celtis occidentalis*, *Fraxinus pennsylvanica*, *Populus deltoides*, *Prunus serotina*, and *Salix nigra*. Frequent prairie fires prevented these fast growing tree species from covering large areas

of the wetland and lower dune slopes (McClain and Elzinga 1994). These fast-growing, fire-sensitive, shade-intolerant taxa were all common forest components at GRSWA during this study.

The forests present at GRSWA during this study were of recent origin. Post-settlement fire suppression had increased the acreage of sand forest at the expense of sand savannas (White and Madany 1978, Anderson and Brown 1986, Anderson 1991, Abrams 1992). These forests, with 80 to 100% canopy cover, had eliminated the common prairie and marsh plants associated with the dune and swale topography typical of Illinois sand deposits.

Management: The management of prairie and marsh communities at GRSWA since 1993, which has included the use of fire on a regular basis and the active removal of brush and trees, has been important in improving the quality of these communities. The high importance values of some exotic species, particularly *Phalaris arundinacea*, indicated that some areas were not recovering rapidly from past disturbances. The presence of the native and conservative prairie taxa, however, indicated that the management practices had, in part, been successful. The use of fire is imperative if the upland sand prairie communities are going to increase in quality and species diversity (Bowles et al. 2003).

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APPENDIX I

Vascular plant species encountered at Green River State Wildlife Area, Lee County, Illinois, are listed alphabetically by family under major plant groups. Collecting numbers preceded by an E (John E. Ebinger) are deposited in the Stover-Ebinger Herbarium, Eastern Illinois University, Charleston, Illinois (EIU). Collecting numbers preceded by a P (Loy R. Phillippe) are deposited in the Illinois Natural History Survey Herbarium, Champaign. (ILLS). (*exotic species)

FERNS AND FERN-ALLIES

Aspleniaceae

Asplenium platyneuron (L.) Oakes: P32588

Dryopteridaceae

Athyrium filix-femina (L.) Martens ssp. *angustum* (Willd.) R.T. Clausen: P32587

Dryopteris carthusiana (Villars) H.P. Fuchs: P32576

Dryopteris cristata (L.) Gray: P31662

Equisetaceae

Equisetum arvense L.: P31501

Equisetum x ferrissii Clute: P31638

Equisetum hyemale L.: P32602

Equisetum laevigatum A. Br.: P31644

Onocleaceae

Onoclea sensibilis L.: P32370

Ophioglossaceae

Botrychium dissectum Spreng.: P32530

Botrychium matricariifolium (Doll.) A. Br.: P31628

Botrychium virginianum (L.) Sw.: P31608

Osmundaceae

Osmunda claytoniana L.: P31483

Osmunda regalis L.: P31577

Thelypteridaceae

Thelypteris palustris Schott: P32451

GYMNOSPERMS

Cupressaceae

Juniperus virginiana L.: P31530

Pinaceae

**Larix decidua* Mill.: P31551

**Pinus banksiana* Lamb.: P31529

**Pinus echinata* Mill.: P32494

**Pinus strobus* L.: P32606

**Pinus sylvestris* L.: P32619

**Pseudotsuga taxifolia* Britt.: P32675

Taxodiaceae

**Taxodium distichum* (L.) Rich.: P32622

MONOCOTS

Alismataceae

Alisma subcordatum Raf.: P32411

Alisma triviale Pursh: P32625

Sagittaria latifolia Willd.: P32365

Amaryllidaceae

Hypoxis hirsuta (L.) Coville: P31507

Commelinaceae

**Commelina communis* L.: P32678

Tradescantia ohiensis Raf.: P31474

Cyperaceae

Bolboschoenus fluviatilis (Torr.) Sojak: P31593

Bulbostylis capillaris (L.) C.B. Clarke: P36135

Carex bicknellii Britt.: P31682

Carex brevior (Dewey) Mack.: P31564

Carex buxbaumii Wahl.: P31613

Carex conoidea Schk.: P31504

Carex cristatella Britt.: P31653

Carex davisii Schwein. & Torr.: P31579

Carex festucacea Schk.: P31589

Carex haydenii Dewey: P31587

Carex lacustris Willd.: P34952

Carex molesta Mack.: P35666

Carex muhlenbergii Schk.: P31562

Carex normalis Mack.: P31713

Carex pellita Willd.: P31633

Carex pensylvanica Lam.: P32641

Carex scoparia Schk.: P36143

Carex stipata Muhl.: P31592

Carex suberecta (Olney) Britt.: P31697

Carex swanii (Fern.) Mack.: P31611

Carex tonsa (Fern.) Bickn.: P31513

Carex tribuloides Vahl: P34684

Carex vesicaria L.: P31508

Carex vulpinoidea Michx.: P31687

Cyperus esculentus L.: P32489

Cyperus lupulinus (Spreng.) Marcks var. *macilentus* (Fern.) Marcks: P32486

Cyperus schweinitzii Torr.: P32608

Cyperus squarrosus L.: P34699

Cyperus strigosus L.: P32412

Eleocharis acicularis (L.) Roem. & Schultes: P32417

Eleocharis compressa Sull.: P31614

Eleocharis ovata (Roth) Roem. & Schultes var. *detonsa* (Gray) Mohlenbr.: P32596

Eleocharis ovata (Roth) Roem. & Schultes var. *obtusa* (Willd.) Kukenth.: P32415

Eleocharis verrucosa (Svenson) Harms: P31673

Eleocharis wolfii Gray: P31615

Fimbristylis autumnalis (L.) Roem. & Schultes: P32687

Schoenoplectus acutus (Muhl.) A. Love & D. Love: P32501

Schoenoplectus heterochaetus (Chase) Sojak: P31683

Scirpus atrovirens Willd.: P32623

Scirpus cyperinus (L.) Kunth: P32373
Scirpus pendulus Muhl.: P31704
Scleria triglomerata Michx.: P31671

Iridaceae

**Iris flavescens* DC.: P35672
Iris shrevei Small: P31581
Sisyrinchium campestre Bickn.: P31511

Juncaceae

Juncus acuminatus Michx.: P32413
Juncus dudleyi Wieg.: E28953
Juncus effusus L.: P32473
Juncus greenei Oakes & Tuckerm.: P31678
Juncus interior Wieg.: P31695
Juncus marginatus Rostk.: P32477
Juncus tenuis Willd.: P31696
Juncus torreyi Coville: P32476

Lemnaceae

Lemna minor L.: P32626
Lemna trisulca L.: P31657

Liliaceae

Allium canadense L.: P31685
**Asparagus officinalis* L.: P31618
**Hemerocallis fulva* (L.) L.: P34599
Lilium michiganense Farw.: P35863
Maianthemum canadense Desf. var. *canadense*: P31607
Polygonatum commutatum (Schult.) A. Dietr.: P31605
Smilacina stellata (L.) Desf.: P31500

Orchidaceae

Corallorrhiza odontorhiza (Willd.) Nutt.: P32631
Goodyera pubescens (Willd.) R. Br.: P32367
Liparis liliifolia (L.) Rich.: P32418
Liparis loeselii (L.) Rich.: P32577
Platanthera flava (L.) Lindl. var. *herbiola* (R. Br.) Luer: P31654
Spiranthes cernua (L.) Rich.: P32431
Spiranthes ovalis Lindl.: P34968

Poaceae

Agrostis gigantea Roth: P31560
Agrostis hyemalis (Walt.) BSP.: R.Evers 108119
Alopecurus carolinianus Walt.: P35654
Andropogon gerardii Vitman: P32354
Aristida basiramea Engelm.: P32521
Aristida intermedia Scribn. & Ball: P32497
Aristida oligantha Michx.: P32573
Aristida tuberculosa Nutt.: P32560
**Avena sativa* L.: P32663
Bouteloua curtipendula (Michx.) Torr.: E28888
Bouteloua hirsuta Lag.: P32569
**Bromus commutatus* Schrad.: P31718

- **Bromus inermis* Leyss.: P31572
**Bromus tectorum* L.: P31540
Calamagrostis canadensis (Michx.) P. Beauv.: P31659
Cenchrus longispinus (Hack.) Fern.: E28917
Cinna arundinacea L.: P32531
**Dactylis glomerata* L.: P31604
Dichanthelium acuminatum (Sw.) Gould & Clark var. *fasciculatum* (Torr.) Freckm.: P31702
Dichanthelium depauperatum (Muhl.) Gould: observed
Dichanthelium oligosanthes (Schult.) Gould var. *scribnerianum* (Nash) Gould: P31475
Dichanthelium perlongum (Nash) Freckm.: P31557
Dichanthelium villosissimum (Nash) Freckm.: P31569
**Digitaria ischaemum* (Schreb.) Schreb.: P32381
**Digitaria sanguinalis* (L.) Scop.: E28891
**Echinochloa crus-galli* (L.) P. Beauv.: P32414
Echinochloa muricata (Michx.) Fern. var. *muricata*: P32515
Echinochloa walteri (Pursh) Heller: P34977
**Eleusine indica* (L.) Gaertn.: P32648
Elymus canadensis L.: P32572
Elymus villosus Muhl.: P32667
Elymus virginicus L.: P32463
**Elytrigia repens* (L.) Desv.: E28909
**Eragrostis cilianensis* (All.) Vign.: P34696
Eragrostis frankii C.A. Meyer var. *frankii*: P32532
Eragrostis hypnoides (Lam.) BSP.: P36136
Eragrostis pectinacea (Michx.) Nees: P34697
Eragrostis spectabilis (Pursh) Steud.: P32427
**Festuca arundinacea* Schreb.: P35661
**Festuca pratensis* Huds.: E28907
Festuca subverticillata (Pers.) E.B. Alexeev.: P35657
Glyceria septentrionalis Hitchc.: P31652
Glyceria striata (Lam.) Hitchc.: P31656
Heterostipa spartea (Trin.) Barkworth: P31599
Hordeum jubatum L.: P32484
Hordeum pusillum Nutt.: P31583
Koeleria macrantha (Ledeb.) Spreng.: P31602
Leersia oryzoides (L.) Swartz: P32448
Leersia virginica Willd.: P32581
Leptoloma cognatum (Schult.) Chase: E28956
**Lolium perenne* L.: P34695
**Miscanthus sacchariflorus* (Maxim.) Hack.: P37113
Muhlenbergia frondosa (Poir.) Fern.: P32524
Muhlenbergia mexicana (L.) Trin.: P32375
Muhlenbergia schreberi J.F. Gmel.: P32384
Panicum capillare L.: P32534
Panicum dichotomiflorum Michx.: P32533
Panicum virgatum L.: E28947
Paspalum bushii Nash: E28957
**Phalaris arundinacea* L.: P31568
**Phleum pratense* L.: E28906
**Phragmites australis* (Cav.) Trin.: P32506
**Poa annua* L.: P35644
**Poa compressa* L.: P31597
**Poa pratensis* L.: P31494
Schizachyrium scoparium (Michx.) Nash: P34677

**Secale cereale* L.: P35651

**Setaria faberii* R.A.W. Herrm.: P32363

Setaria glauca (L.) P. Beauv.: P32438

**Setaria viridis* (L.) P. Beauv.: E28916

Sorghastum nutans (L.) Nash: P32350

Spartina pectinata Link: P32374

Sporobolus cryptandrus (Torr.) Gray: P32426

Sporobolus heterolepis (Gray) Gray: P32496

Sporobolus vaginiflorus (Torr.) A. Wood: P32491

Tridens flavus (L.) Hitchc.: P32586

Triplasis purpurea (Walt.) Chapm.: P32604

**Triticum aestivum* L.: P35659

Vulpia octoflora (Walt.) Rydb. var. *glauca* (Nutt.) Fern.: P31567

Vulpia octoflora (Walt.) Rydb. var. *tenella* (Willd.) Fern.: P35658

Smilacaceae

Smilax lasioneuron Hook.: P32518

Smilax tamnoides L.: P32582

Sparganiaceae

Sparganium eurycarpum Engelm.: P32504

Typhaceae

Typha angustifolia L.: P34971

Typha latifolia L.: P32595

DICOTS

Aceraceae

Acer negundo L.: P31545

Acer saccharinum L.: P31368

Amaranthaceae

Amaranthus albus L.: P32593

**Amaranthus hybridus* L.: P32652

**Amaranthus powellii* S. Wats.: P32566

**Amaranthus retroflexus* L.: P32660

Amaranthus tuberculatus (Moq.) J. Sauer: P32565

Froelichia floridana (Nutt.) Moq.: E28940

Froelichia gracilis (Hook.) Moq.: P32487

Anacardiaceae

Rhus aromatica Ait. var. *arenaria* (Greene) Fern.: P31518

Rhus glabra L.: P31710

Toxicodendron radicans (L.) Kuntze: P31723

Apiaceae

Angelica atropurpurea L.: P34607

Cicuta maculata L.: P31655

**Conium maculatum* L.: P35650

Cryptotaenia canadensis (L.) DC.: P31660

**Daucus carota* L.: E28901

Eryngium yuccifolium Michx.: P32544

Osmorhiza claytonii (Michx.) C.B. Clarke: P31612

Osmorrhiza longistylis (Torr.) DC.: P31482

Oxypolis rigidior (L.) Raf.: P32467

**Pastinaca sativa* L.: P31570

Polytaenia nuttallii DC.: P31601

Sanicula canadensis L. var. *canadensis*: P31665

Sanicula odorata (Raf.) Pryer & Phillippe: P32645

Sium suave Walt.: P32509

Zizia aurea (L.) Koch: P31512

Apocynaceae

Apocynum cannabinum L.: E28918

Apocynum sibiricum Jacq.: P31686

Asclepiadaceae

Asclepias amplexicaulis Small: P31582

Asclepias hirtella (Pennell) Woodson: P31670

Asclepias incarnata L.: E28919

Asclepias sullivantii Engelm.: P31690

Asclepias syriaca L.: P31667

Asclepias verticillata L.: E28944

Asclepias viridiflora Raf.: P31647

Asteraceae

**Achillea millefolium* L.: P31563

Ageratina altissima (L.) R.M. King & H. Robins.: E28897

Ambrosia artemisiifolia L.: P32353

Ambrosia psilostachya DC.: E28959

Ambrosia trifida L.: P32485

Antennaria neglecta Greene: P31491

Antennaria plantaginifolia (L.) Hook.: P32643

**Arctium minus* Schk.: P36134

Arnoglossum plantagineum Raf.: P34676

Artemisia campestris L.: P32391

Aster ericoides L.: P32551

Aster lanceolatus Willd.: P32540

Aster novae-angliae L.: P32466

Aster oblongifolius Nutt.: P32689

Aster ontarionis Wieg.: P32590

Aster oolentangiensis Riddell: P32638

Aster pilosus Willd.: P32555

Aster praealtus Poir.: P34953

Aster puniceus L.: P32460

Aster sericeus Vent.: P32664

Bidens bipinnata L.: P32629

Bidens cernua L.: P32644

Bidens comosa (Gray) Wieg.: P32539

Bidens coronata (L.) Britt.: P32455

Bidens vulgata Greene: P32526

Boltonia asteroides (L.) L'Hér var. *recognita* (Fern. & Grisc.) Cronq.: P32420

Brickellia eupatorioides (L.) Shinners: E28949

Chrysopsis camporum Greene: P31565

**Cichorium intybus* L.: P34692

**Cirsium arvense* (L.) Scop.: E28914

Cirsium discolor (Muhl.) Spreng.: P32390

- **Cirsium vulgare* (Savi) Tenore: P32592
Conoclinium coelestinum (L.) DC.: observed
Conyza canadensis (L.) Cronq.: P32352
Coreopsis lanceolata L.: P31558
Coreopsis palmata Nutt.: P32495
Echinacea pallida (Nutt.) Nutt.: P31706
Erechtites hieracifolia (L.) Raf.: P32358
Erigeron annuus (L.) Pers.: P31715
Erigeron philadelphicus L.: P31584
Erigeron strigosus Muhl.: P31561
Eupatoriadelphus maculatus (L.) R.M. King & H. Robins.: P32456
Eupatoriadelphus purpureus (L.) R.M. King & H. Robins.: P32671
Eupatorium altissimum L.: P32440
Eupatorium perfoliatum L.: P32369
Eupatorium serotinum Michx.: P32446
Euthamia graminifolia (L.) Nutt.: P34949
Euthamia gymnospermoides Greene: P32349
Helenium autumnale L.: P32464
**Helianthus annuus* L.: P34685
Helianthus grosseserratus Martens: E28926
Helianthus occidentalis Riddell: E28943
Helianthus pauciflorus Nutt.: P32428
Helianthus tuberosus L.: P32408
Heliopsis helianthoides (L.) Sweet: P32442
Hieracium longipilum Torr.: E28942
Ionactis linariifolius (L.) Greene: P32570
Krigia virginica (L.) Willd.: P31471
Lactuca canadensis L.: P32366
Lactuca floridana (L.) Gaertn.: P34689
**Lactuca serriola* L.: P32653
**Leucanthemum vulgare* Lam.: P31711
Liatris aspera Michx.: P32421
Liatris pycnostachya Michx.: E28931
**Matricaria discoidea* DC.: P31539
Oligoneuron rigidum (L.) Small: P32424
Parthenium integrifolium L.: P31703
Prenanthes racemosa Michx.: P32610
Pseudognaphalium obtusifolium (L.) Hilliard & Burtt.: P32382
Ratibida pinnata (Vent.) Barnh.: P32441
Rudbeckia hirta L.: P31643
Rudbeckia subtomentosa Pursh: P32377
Senecio plattensis Nutt.: P31492
Silphium integrifolium Michx.: E28928
Silphium laciniatum L.: P32616
Silphium terebinthinaceum Jacq.: P32682
Solidago canadensis L.: P32549
Solidago gigantea Ait.: P32360
Solidago missouriensis Nutt. var. *fasciculata* Holz.: E28950
Solidago nemoralis Ait.: P32557
Solidago speciosa Nutt.: P32522
**Sonchus arvensis* L. var. *glabrescens* Grab. & Wimm.: P32585
**Sonchus asper* (L.) Hill: P34608
**Taraxacum officinale* Weber: P31479
**Tragopogon dubius* Scop.: P31485

**Tragopogon pratensis* L.: P35664

Vernonia fasciculata Michx.: P32434

Xanthium strumarium L. var. *canadense* (Mill.) Torr. & Gray: P32568

Balsamiaceae

Impatiens pallida Nutt.: observed

Bignoniaceae

Campsis radicans (L.) Seem.: E28900

**Catalpa speciosa* Warder: P31708

Boraginaceae

Hackelia virginiana (L.) I.M. Johnston: P32385

Lithospermum croceum Fern.: P31473

Lithospermum incisum Lehm.: P32630

Brassicaceae

**Alliaria petiolata* (Bieb.) Cavara & Grande: P31480

**Arabidopsis thaliana* (L.) Heynh.: P35643

Arabis glabra (L.) Bernh.: P31719

**Barbarea vulgaris* R. Br.: P31484

**Berteroa incana* (L.) DC.: P31535

**Capsella bursa-pastoris* (L.) Medic.: P31369

Cardamine bulbosa (Muhl.) BSP: P31588

Cardamine pensylvanica Willd.: P31610

Draba reptans (Lam.) Fern.: P31516

**Erysimum cheiranthoides* L.: P31527

**Erysimum inconspicuum* (S. Wats.) MacM.: P31642

**Erysimum repandum* L.: P35648

**Hesperis matronalis* L.: P34610

**Lepidium campestre* (L.) R. Br.: P31525

**Lepidium densiflorum* Schrad.: P31677

Lepidium virginicum L.: P31476

Nasturtium officinale R. Br.: P31609

Rorippa palustris (L.) Besser var. *fernaldiana* (Butters & Abbe) Stuckey: P32600

Rorippa sessiliflora (Nutt.) A. Hitchc.: P32564

**Sisymbrium altissimum* L.: P31536

**Sisymbrium loeselii* L.: E28905

**Thlaspi arvense* L.: P31499

Caesalpiniaceae

Chamaecrista fasciculata (Michx.) Greene: E28936

Campanulaceae

Campanula aparinoides Pursh: P32457

Campanulastrum americanum (L.) Small: E28896

Lobelia cardinalis L.: P36133

Lobelia siphilitica L.: P32425

Lobelia spicata Lam.: P31575

Triodanis perfoliata (L.) Neiuwl.: P31622

Cannabinaceae

**Cannabis sativa* L.: P31646

Capparaceae

Polanisia dodecandra (L.) DC.: P32655

Caprifoliaceae

- **Lonicera x bella* Zabel: P 31519, P 32520
- **Lonicera maackii* (Rupr.) Maxim.: P 31481
- **Lonicera morrowii* Gray: P 35649
- Sambucus canadensis* L.: P 31707
- **Viburnum opulus* L.: P 31552
- Viburnum prunifolium* L.: P 35667

Caryophyllaceae

- **Arenaria serpyllifolia* L.: P35647
- **Cerastium fontanum* Baum: P31497
- Cerastium nutans* Raf.: P31526
- **Dianthus armeria* L.: P31645
- **Holosteum umbellatum* L.: P31541
- **Saponaria officinalis* L.: E28915
- Silene antirrhina* L.: P31641
- **Silene pratensis* (Spreng.) Godron & Gren.: P31495
- **Stellaria media* (L.) Cyrillo: P31496

Celastraceae

Celastrus scandens L.: P32674

Chenopodiaceae

- **Chenopodium album* L.: P32510
- Chenopodium standleyanum* Aellen: P32393
- **Monolepis nuttalliana* (Roem. & Schultes) Greene: P35646

Cistaceae

- Helianthemum bicknellii* Fern.: P31595
- Helianthemum canadense* (L.) Michx.: P32668
- Lechea intermedia* Britt.: P37119
- Lechea stricta* Leggett: P32603
- Lechea tenuifolia* Michx.: E28958

Convolvulaceae

Calystegia sepium (L.) R. Br.: P31674

Cornaceae

- Cornus obliqua* Raf.: P31712
- Cornus racemosa* Lam.: P31714
- Cornus sericea* L.: P31544

Corylaceae

Corylus americana Walt.: P32519

Crassulaceae

- **Sedum telephium* L.: P36137

Cucurbitaceae

Echinocystis lobata (Michx.) Torr. & Gray: P32436

Cuscutaceae

- Cuscuta gronovii* Willd. var. *gronovii*: E28960
Cuscuta pentagona Engelm.: P32627

Elaeagnaceae

- **Elaeagnus umbellata* Thunb.: P31550

Euphorbiaceae

- Acalypha gracilens* Gray var. *gracilens*: P32529
Acalypha rhomboidea Raf.: E28899
Chamaesyce maculata (L.) Small: P32517
Chamaesyce nutans (Lag.) Small: P32439
Euphorbia corollata L.: E28945
Poinsettia dentata (Michx.) Kl. & Garske: P32656

Fabaceae

- Amorpha canescens* Pursh: E28941
Amorpha fruticosa L.: P31619
Amphicarpaea bracteata (L.) Fern. var. *bracteata*: observed
Apios americana Medic.: P32673
Astragalus canadensis L.: P34602
Baptisia alba (L.) Vent: E28952
Baptisia bracteata Ell. var. *glabrescens* (Larisey) Isely: P31490
Dalea purpurea Vent.: E28948
Desmodium canadense (L.) DC.: E28935
Desmodium illinoense Gray: P32443
**Kummerowia striata* (Thunb.) Schind.: P32387
Lathyrus palustris L. var. *palustris*: P31692
Lespedeza capitata Michx.: P32422
**Lespedeza cuneata* (Dum.-Cours.) G. Don: P32688
**Lotus corniculatus* L.: P34674
**Medicago lupulina* L.: P31498
**Medicago sativa* L.: P31640
**Melilotus albus* Medic.: P31648
**Melilotus officinalis* (L.) Pallas: P31639
**Robinia pseudoacacia* L.: P32575
Tephrosia virginiana (L.) Pers.: P31668
**Trifolium campestre* Schreb.: P31722
**Trifolium hybridum* L.: P31721
**Trifolium pratense* L.: P31573
**Trifolium repens* L.: P31488
**Vicia villosa* Roth: P31636

Fagaceae

- Quercus velutina* Lam.: P31478

Gentianaceae

- Gentiana andrewsii* Griseb.: P32545
Gentiana puberulenta J. Pringle: P32640

Grossulariaceae

- Ribes americanum* Mill.: P31549
Ribes missouriense Nutt.: P34609

Hypericaceae

- Hypericum canadense* L.: P32599
Hypericum gentianoides (L.) BSP.: P32665
**Hypericum perforatum* L.: E28908
Hypericum punctatum Lam.: E28932
Hypericum sphaerocarpum Michx.: P32611
Triadenum fraseri (Spach) Gl.: P32447

Juglandaceae

- Juglans nigra* L.: P32618

Lamiaceae

- **Chaiturus marrubiastrum* (L.) Reichenb.: P32601
**Glechoma hederacea* L.: P32658
Hedeoma hispida Pursh: P31627
**Lamium amplexicaule* L.: P35645
**Leonurus cardiaca* L.: E28911
Lycopus americanus Muhl.: P32361
Lycopus uniflorus Michx.: P32458
**Mentha arvensis* L.: E28913
Monarda fistulosa L.: E28938
Monarda punctata L.: E28946
**Nepeta cataria* L.: E28895
Physostegia speciosa (Sweet) Sweet: P34976
Physostegia virginiana (L.) Benth.: P32462
**Prunella vulgaris* L.: E28912
Pycnanthemum virginianum (L.) Dur. & B.D. Jacks.: E28925
**Salvia reflexa* Hornem.: P32661
Scutellaria galericulata L.: P32500
Scutellaria lateriflora L.: P32355
Scutellaria leonardii Epling: P35665
Stachys pilosa Nutt. var. *homotricha* (Fern) Mohlenbr.: P31701
Teucrium canadense L.: E28923

Linaceae

- Linum sulcatum* Riddell: P32397

Lythraceae

- Ammannia coccinea* Rottb.: P32567
Lythrum alatum Pursh: P31672
**Lythrum salicaria* L.: P32371
Rotala ramosior (L.) Koehne: P32597

Malvaceae

- **Abutilon theophrasti* Medic.: P32584
Hibiscus laevis All.: P32503
**Malva neglecta* Wallr.: P31538
**Sida spinosa* L.: P32583

Melastomataceae

- Rhexia virginica* L.: E28934

Molluginaceae

- **Mollugo verticillata* L.: E28890

Moraceae

**Maclura pomifera* (Raf.) Schneider: P32499

**Morus alba* L.: P34606

**Morus tatarica* L.: P34605

Nyctaginaceae

**Mirabilis nyctaginea* (Michx.) MacM.: P31571

Oleaceae

Fraxinus pennsylvanica Marsh.: P31546

Onagraceae

Epilobium coloratum Spreng.: P32511

Epilobium leptophyllum Raf.: P32453

Gaura biennis L.: P32635

Ludwigia alternifolia L.: E28933

Ludwigia palustris (L.) Ell.: P32637

Ludwigia polycarpa Short & Peter: P32356

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Oenothera clelandii W. Dietr., Raven, & W.L. Wagner: E28951

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Oxalidaceae

Oxalis stricta L.: P31486

Oxalis violacea L.: P31505

Phrymaceae

Phryma leptostachya L.: P32386

Phytolaccaceae

Phytolacca americana L.: E28894

Plantaginaceae

Plantago aristata Michx.: P31684

**Plantago lanceolata* L.: P31576

Plantago patagonica Jacq.: P32445

Plantago rugelii Decnè.: P32351

Polemoniaceae

Phlox bifida Beck: P31524

Phlox maculata L.: P31699

Polygalaceae

Polygala polygama Walt.: P31559

Polygala sanguinea L.: E28930

Polygala verticillata L. var. *isocycla* Fern.: P32392

Polygonaceae

Antennaria virginianum (L.) Roberty & Vautier: P32670

**Fallopia convolvulus* (L.) A. Love: P34601

Fallopia scandens (L.) Holub: P32430

Persicaria amphibia (L.) S.F. Gray: E28922

- **Persicaria cespitosa* (Blume) Nakai: P34604
Persicaria coccinea (Muhl.) Greene: P40241
**Persicaria hydropiper* (L.) Opiz: P32624
Persicaria hydropiperoides (Michx.) Small: P31680
Persicaria lapathifolia (L.) S.F. Gray: P32512
Persicaria pensylvanica (L.) Small: P32362
Persicaria punctata (Ell.) Small: P32364
**Persicaria vulgaris* Webb & Moq.: P32651
Polygonum achoreum S.F. Blake: P34688
**Polygonum arenastrum* Boreau: P32657
Polygonum ramosissimum Michx.: P32516
Polygonum tenue Michx.: P32398
**Rumex acetosella* L.: P31533
Rumex altissimus Wood: P31689
**Rumex crispus* L.: P31694
Rumex orbiculatus Gray: P32508
Tracaulon sagittatum (L.) Small: P32376

Portulacaceae

- **Portulaca oleracea* L.: E28892
Talinum rugospermum Holz.: P32558

Primulaceae

- Lysimachia lanceolata* Walt.: P32492
Lysimachia quadriflora Sims: P32465
Lysimachia thyrsiflora L.: P34975

Ranunculaceae

- Anemone canadensis* L.: P31591
Anemone cylindrica Gray: P32617
Anemone virginiana L.: P34680
Caltha palustris L.: P31590
Ranunculus abortivus L.: P31509
Ranunculus longirostris Godr.: P31658
Ranunculus pensylvanicus L. f.: E28898
Ranunculus sceleratus L.: P32685
Thalictrum dasycarpum Fisch. & Lall. var. *hypoglaucum* (Rydb.) Boivin: P31556

Rhamnaceae

- **Rhamnus cathartica* L.: P32647

Rosaceae

- Agrimonia parviflora* Sol.: E28893
Crataegus mollis (Torr. & Gray) Scheele: P31631
Fragaria virginiana Duchesne: P31477
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Geum laciniatum Murr.: P31700
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**Malus pumila* Mill.: P31502
Physocarpus opulifolius (L.) Maxim.: P31709
**Potentilla argentea* L.: P31517
Potentilla arguta Pursh: E28924
**Potentilla norvegica* L.: P32505
**Potentilla recta* L.: P31649

- Potentilla simplex* Michx.: P31489
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Prunus angustifolia Marsh.: P32493
Prunus pensylvanica L. f.: P35671
Prunus serotina Ehrh.: P31487
Prunus virginiana L.: P31521
**Rosa arkansana* Porter: P32553
**Rosa damascena* Mill.: P35671
Rosa carolina L.: P31594
**Rosa multiflora* Thunb.: P31606
**Rosa spinosissima* L.: P35670
Rubus allegheniensis Porter: P31623
Rubus flagellaris Willd.: P31600
Rubus occidentalis L. Bailey: P31534
Rubus pensylvanicus Poir.: P32498
Spiraea alba DuRoi: P32432

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- Diodia teres* Walt.: E28954
Galium aparine L.: P31493
Galium obtusum Bigel.: P31688
**Galium pedemontanum* (Bellardi) All.: P35653
Galium tinctorium L.: P32452
Galium triflorum Michx.: P31661

Rutaceae

- Ptelea trifoliata* L.: E28902

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- Populus deltoides* Marsh.: P31716
Populus grandidentata Michx.: P32677
Populus tremuloides Michx.: P32548
Salix amygdaloidea Anders.: P31548
Salix discolor Muhl.: P32475
**Salix fragilis* L.: P32523
Salix humilis Marsh.: P32550
Salix interior Rowlee: P31547
Salix nigra Marsh.: P32620

Santalaceae

- Comandra umbellata* (L.) Nutt.: P31510

Saxifragaceae

- Heuchera richardsonii* R. Br.: P31693
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- Agalinis purpurea* (L.) Pennell: P32470
Agalinis tenuifolia (Vahl) Raf.: P32472
Chelone glabra L.: P32513
Gratiola neglecta Torr.: P35669
Leucospora multifida (Michx.) Nutt.: P32536
Lindernia anagallidea (Michx.) Pennell: P32416
Mimulus ringens L.: P32502
Nuttallanthus canadensis (L.) D. Sutton: P31532
Pedicularis lanceolata Michx.: P32433
Penstemon pallidus Small: P31528
Scrophularia lanceolata Pursh: P31626

**Verbascum thapsus* L.: E28903

**Veronica arvensis* L.: P31514

Veronica peregrina L.: P31515

Veronicastrum virginicum (L.) Farw.: E28927

Solanaceae

**Datura stramonium* L.: P32649

Physalis subglabrata Mack. & Bush: P32659

Physalis virginiana Mill.: P31596

Solanum carolinense L.: P32404

**Solanum dulcamara* L.: P31691

Solanum ptychanthum Dunal: E28889

Ulmaceae

Celtis occidentalis L.: P32388

Ulmus americana L.: P32525

**Ulmus pumila* L.: P32401

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Urticaceae

Boehmeria cylindrica (L.) Sw.: E28921

Parietaria pensylvanica Muhl.: P31616

Pilea pumila (L.) Gray: P32528

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Verbenaceae

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Verbena bracteata Lag. & Rodr.: P31603

Verbena hastata L.: E28939

Verbena stricta Vent.: E28904

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Viola lanceolata L.: P31506

Viola pedata L.: P31531

Viola pratincola Greene: P32579.1

Viola pubescens Ait.: P34611

**Viola rafinesquei* Greene: P31522

Viola sagittata Ait.: P31472

Viola sororia Willd.: P32579.2

Vitaceae

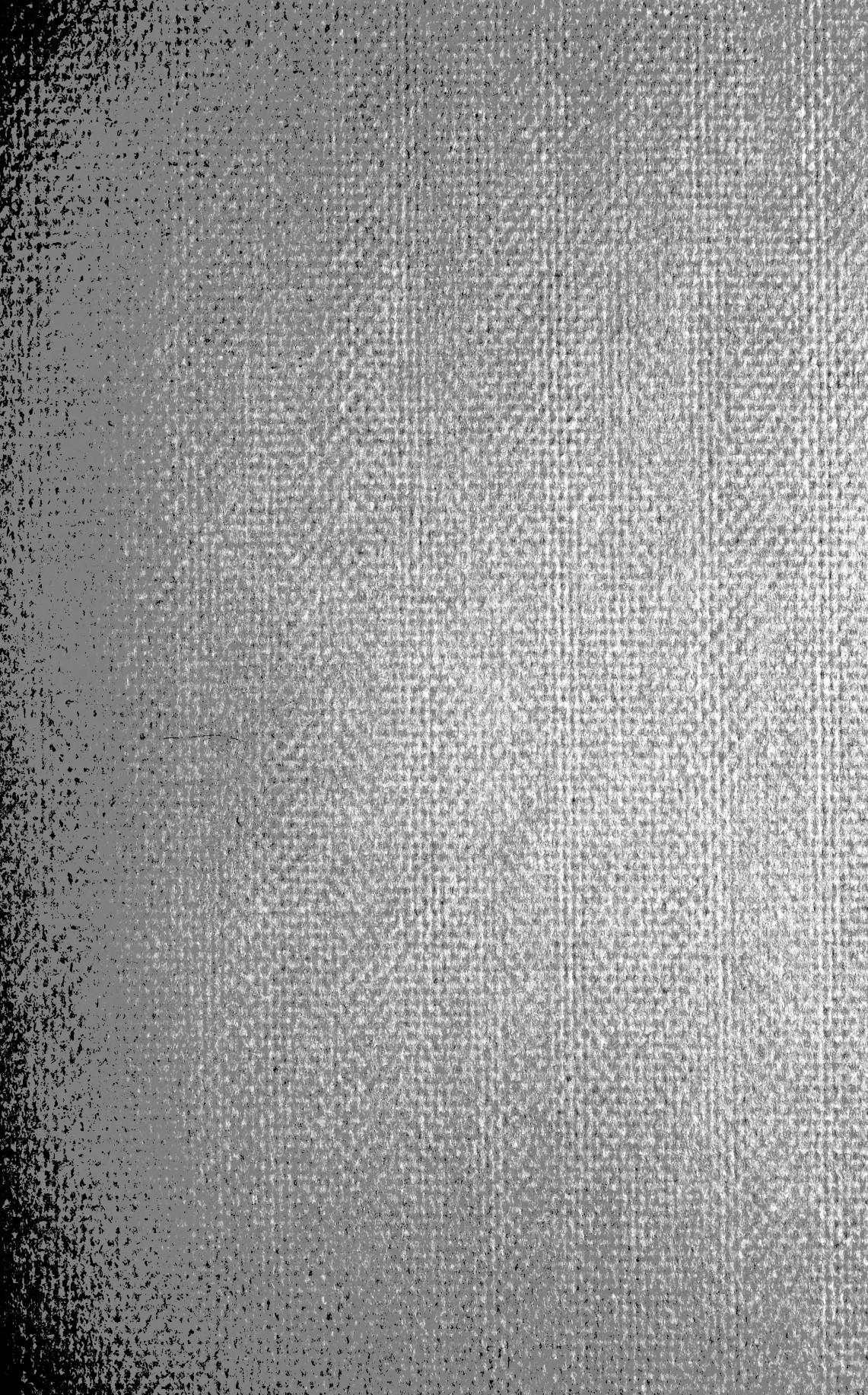
Parthenocissus inserta (Kern.) K. Fritsch: P32396

Parthenocissus quinquefolia (L.) Planch.: P32543

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Zygophyllaceae

Tribulus terrestris L.: P34693



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